

DOCUMENT RESUME

ED 299 390

CE 050 891

TITLE Curriculum in Industrial Technology. Plastics Technology. Industrial Maintenance. Computer Numerical Control. Teacher's Manuals and Student Learning Guides.

INSTITUTION El Paso Community Coll., Tex.

SPONS AGENCY Texas Higher Education Coordinating Board, Austin.

PUB DATE Jun 88

NOTE 275p.

PUB TYPE Guides - Classroom Use - Materials (For Learner) (051) -- Guides - Classroom Use - Guides (For Teachers) (052)

EDRS PRICE MF01/PC11 Plus Postage.

DESCRIPTORS Behavioral Objectives; *Computer Software; Curriculum Guides; Industrial Arts; *Industry; Learning Activities; *Maintenance; *Numerical Control; *Plastics; Postsecondary Education; Programers; Student Evaluation; Technical Education; *Technology; Trade and Industrial Education

ABSTRACT

Curriculum guides are provided for plastics technology, industrial maintenance, and computer numerical control. Each curriculum is divided into a number of courses. For each course these instructor materials are presented in the official course outline: course description, course objectives, unit titles, texts and materials, instructor resources, and evaluation measures. Student learning guide materials for each course include the competency, introduction, performance objective, performance enablers, learning experiences, self-checks, and performance tests. Courses in the plastics technology curriculum are plastic materials and application, injection molds and mold maintenance, injection molding machine operation, injection molding process control and troubleshooting, and auxiliary equipment and material handling. The industrial maintenance curriculum has these courses: pneumatic controls, hydraulics II, hydraulics III, print reading for machine trades, and mechanical maintenance. The computer numerical control curriculum contains a course in numerical control (NC)/computer numerical control (CNC) programming. (YLB)

* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *

ED 299390

CURRICULUMS IN INDUSTRIAL TECHNOLOGY

- **Plastics Technology**
- **Industrial Maintenance**
- **Computer Numerical Control**

TEACHER'S MANUALS AND STUDENT LEARNING GUIDES

**A Project Funded by the Carl D. Perkins Act
Under the Texas Higher Education Coordinating Board**

Project Number 8788053

"PERMISSION TO REPRODUCE THIS
MATERIAL HAS BEEN GRANTED BY

(c) El Paso Community College

June 1988

TO THE EDUCATIONAL RESOURCES
INFORMATION CENTER (ERIC)."

U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement
EDUCATIONAL RESOURCES INFORMATION
CENTER (ERIC)

☒ This document has been reproduced as
received from the person or organization
originating it.

☐ Minor changes have been made to improve
reproduction quality.

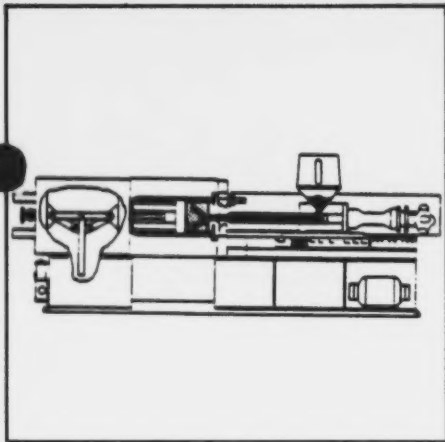
• Points of view or opinions stated in this docu-
ment do not necessarily represent official
OERI position or policy.

M. Park

Dr. Diane K. Troyer, Administrator
Carlos Veloz, Coordinator
Uwe Agness, Assistant Coordinator
Donald G. Pearson, Editor/Designer
Endre Kozma, Plastics Technology
Robert Weirich, Industrial Maintenance
Francisco Avila, Computer Numerical Control
Maria B. Acosta, Secretary

**Advanced Industrial Technology Training Center
c/o El Paso Community College
P. O. Box 20500
El Paso, Texas 79998**

168 050 891



Student Learning Guide

A Project Funded by
The Texas Higher Education
Coordinating Board
Through the
Carl D. Perkins Act
Project No. 8788053

PLASTIC INJECTION MOLDING



**EL PASO
COMMUNITY
COLLEGE**

P.O. Box 20500, El Paso, Texas 79998

ADVANCED INDUSTRIAL TECHNOLOGY TRAINING CENTER

©1988, El Paso Community College

OFFICIAL COURSE OUTLINE

Curriculum Title: Plastics Technology

Course Title: Plastic Materials and Application

Subject Area Code:

I. Course Description

This course covers the elementary structure, properties, applications, and characteristics of plastic products, as well as production methods used to make plastic products.

II. Course Objectives

Upon satisfactory completion of this course, the student will be able to:

- A. Identify various types of materials.
- B. Identify the molecular structure of plastic materials.
- C. Define molding processes.
- D. Identify thermosetting plastics.
- E. Identify thermoplastic materials.
- F. Define the extrusion process.
- G. Define the compression molding process.
- H. Define the vacuum forming process.
- I. Define what reinforcement (filler) is.

III. Unit Titles

- A. Unit I — Structures of Plastic Materials. This unit is an introduction to plastics and deals with the molecular structure of plastic materials.

- B. Unit II — Types of Materials, Additives, and Applications. This unit introduces various types of plastic materials, additives, and typical applications.
- C. Unit III — Processes and Production Methods. This unit introduces the major production methods used to make plastic materials.

IV. Texts and Materials

- A. Text: Chemistry: Atom and Molecule, Barron's Educational Series, Inc. (to be ordered from publisher or obtained from bookstore).

Injection Molding Handbook, D. V. Rosato, Van Nostrand Reinhold Co.

Industrial Plastics, Richardson, Terry L., South-Western Publishing Co.
- B. Study Aids: Video tapes and related workbooks from Paulson Video Training Course, "Injection Molding Technology."

IV. Instructor Resources

- A. Books: Industrial Plastics, Richardson, T. L., South-Western Publishing Co.

Injection Molding Handbook, Rosato, D. V., Van Nostrand Reinhold Co.

Injection Molds and Molding, Dym, J. B., Van Nostrand Reinhold Co.
- B. Video tapes and related study guide from Paulson Video Training Course.

V. Evaluation Measures

The skills and knowledge for identification and demonstration as stated in the objectives will be evaluated by assignments and tests. These performances will be averaged, and a letter grade will be assigned as follows:

90 - 100	A
80 - 89	B
70 - 79	C
60 - 70	D
0 - 59	F

Students should be able to compute their grade average anytime during the course. Missed assignments and make-up tests will be given at the discretion of the instructor.

STUDENT LEARNING GUIDE

Advanced Industrial Technology Training Center
c/o El Paso Community College
P.O. Box 20500
El Paso, Texas 79998

COURSE NUMBER AND TITLE: Plastic Materials and Applications

DUTY/UNIT: Structures of Plastic Materials

COMPETENCY NUMBER: 1

COMPETENCY: DEFINE A COMPOUND AND ITS STRUCTURE

INTRODUCTION:

In this unit you will learn about the history of plastics, the basics of organic chemistry, and the molecular structure of plastic materials. This learning guide will help you to acquire this knowledge.

PERFORMANCE OBJECTIVE:

Given appropriate instruction, define a compound and its structure. Your performance will be evaluated by your instructor, using the performance test.

PERFORMANCE ENABLERS:

1. Define a compound and its structure.

Please Do Not Write Or Mark On This Guide

(c) El Paso Community College, 1988

LEARNING EXPERIENCES

Performance Enabler No. 1

Define a compound and its structure.

LEARNING ACTIVITIES

SPECIAL INSTRUCTIONS

Please Do Not Write Or Mark On This Guide

Read: Chemistry: Atom and Molecule,
pp. 1-38, pp. 61-67, pp. 153-157

Read: Industrial Plastics, pp. 1-19

View: Video Tape #1, "Structure and
Properties of Plastics" (Paulson In-
jection Molding Technology)

To check your knowledge, go through
workbook, Session 1, "Plastic Compo-
sition and Properties."

This is an introduc-
tion to matter, ato-
mic structure, bond-
ing, molecules, and
organic chemistry.

This is an introduc-
tion to plastics and
organic chemistry.

This tape introduces
the characteristics
of polymers.

(c) El Paso Community College, 1988

SELF-CHECK

DIRECTIONS

Choose a "YES" or "NO" answer for each of the questions 1-11; write complete answers for the remaining questions.

Please Do Not Write Or Mark On This Guide

	YES	NO
1. Is the atom an element?		
2. Is the molecule an element?		
3. Is water a compound?		
4. Are monomers individual units?		
5. Does <u>mono</u> mean "many"?		
6. Does <u>mono</u> mean "unit"?		
7. Does <u>poly</u> mean "single"?		
8. Does <u>mono</u> mean "single"?		
9. Does <u>poly</u> mean "many"?		
10. Does <u>mer</u> mean "unit"?		
11. As temperature increases, does the space between each molecule decrease?		
12. Define "density."		
13. Define "viscosity."		
14. Define "tensile strength."		
15. What is a stabilizer?		
16. Name the characteristics of ABS.		
17. Name the characteristics of PVC.		
18. What is blow molding?		
19. What is the hemisphering process?		

PERFORMANCE TEST

STUDENT'S NAME

DATE

COMPETENCY NUMBER AND STATEMENT

TEST ATTEMPT

1. Define a compound and its structure.

1ST 2ND 3RD

DIRECTIONS
(see below)

OVERALL EVALUATION:

PERFORMANCE LEVELS

- 4 Can perform this skill without supervision and with initiative and adaptability to problem situations.
- 3 Can perform this skill satisfactorily without assistance or supervision.
- 2 Can perform this skill satisfactorily but requires some assistance and/or supervision.
- 1 Can perform parts of this skill satisfactorily but requires considerable assistance and/or supervision.
- 0 Cannot perform this skill.

PERFORMANCE STANDARDS

For acceptable achievement, all items should receive a "yes" or "not applicable" response.

	YES	NO	NOT APPL.
Directions: In the presence of your instructor, you will answer the following questions. You will be evaluated by the answers you give on the checklist.			
<u>Performance Standards (circle 1 answer)</u>			
1. The atom is			
a. composed of molecules.			
b. a positively charged particle.			
c. the smallest particle of an element.			
d. called a proton.			

PERFORMANCE TEST (CONT.)

PERFORMANCE STANDARDS

FOR ACCEPTABLE ACHIEVEMENT, ALL ITEMS SHOULD RECEIVE A "YES" OR "NOT APPLICABLE" RESPONSE
YES NO NOT APPL.

- | | | | |
|--|--|--|--|
| 2. The molecule is | | | |
| a. a compound containing elements. | | | |
| b. the energy level of an electron. | | | |
| c. an arrangement of the electrons. | | | |
| d. two or more electrons. | | | |
| 3. A monomer is | | | |
| a. a simple molecule that can form polymers. | | | |
| b. a subatomic particle. | | | |
| c. a vinyl structure. | | | |
| 4. Polymerization is a chemical process which | | | |
| a. combines electrons into a chain. | | | |
| b. combines monomers into a polymer chain. | | | |
| c. Combines plastic materials together. | | | |
| 5. A polymer is | | | |
| a. a giant molecule formed from smaller molecules called monomers. | | | |
| b. A small molecule formed from large molecules. | | | |
| 6. What is this structure called? | | | |
| a. Polystyrene. | | | |
| b. PVC. | | | |
| c. Polyethelene. | | | |
| d. Polypropylene. | | | |
| 7. To make plastics, two basic types of polymerization are being used: | | | |
| a. subtraction and addition. | | | |
| b. crosslinking. | | | |
| c. addition and condensation. | | | |

(continued...)

Please Do Not Write Or Mark On This Guide

PERFORMANCE TEST (CONT.)

PERFORMANCE STANDARDS

FOR ACCEPTABLE ACHIEVEMENT, ALL ITEMS SHOULD RECEIVE A "YES" OR "NOT APPLICABLE" RESPONSE
YES NO NOT APPL.

- | | | | |
|---|--|--|--|
| 8. In a crystalline polymer, the molecules have
a. a disordered structure.
b. an ordered structure resulting from internal forces.
c. a linear structure. | | | |
| 9. Crystalline materials above the melting temperature
a. don't exist.
b. will not melt.
c. will not flow.
d. will restructure. | | | |
| 10. If a part shrinkage is .020 in/in, we are dealing with a plastic material which is a
a. homopolymer.
b. thermoplastic.
c. thermoset.
d. crystalline. | | | |
| 11. Amorphous materials have
a. greater shrinkage.
b. don't have an order to their molecules. | | | |
| 12. If thermoplastic materials overheated, they could change their chemical structure, which would affect behavior and quality standards. This is called
a. copolymer.
b. degradation.
c. amorphous. | | | |
| 13. What is a homopolymer? | | | |
| (continued...) | | | |

Please Do Not Write Or Mark On This Guide

PERFORMANCE TEST (CONT.)

PERFORMANCE STANDARDS

FOR ACCEPTABLE ACHIEVEMENT, ALL ITEMS SHOULD RECEIVE A "YES" OR "NOT APPLICABLE" RESPONSE
YES NO NOT APPL.

- | | YES | NO | NOT APPL. |
|---|-----|----|-----------|
| 14. What is a copolymer? | | | |
| 15. What is the difference between thermoplastic and thermoset materials? | | | |

Please Do Not Write Or Mark On This Guide

STUDENT LEARNING GUIDE

**Advanced Industrial Technology Training Center
c/o El Paso Community College
P.O. Box 20500
El Paso, Texas 79998**

COURSE NUMBER AND TITLE: Plastic Materials and Applications

DUTY/UNIT: Types of Materials and Applications

COMPETENCY NUMBER: 2

COMPETENCY: EXPLAIN APPLICATIONS OF PLASTIC MATERIALS

INTRODUCTION:

This guide will introduce the various types of plastic materials and additives, their identification, and their applications and properties. This learning guide will help you to acquire this knowledge.

PERFORMANCE OBJECTIVE:

Given appropriate instruction, explain applications of plastic materials. Your performance will be evaluated by your instructor, according to the performance checklist.

PERFORMANCE ENABLERS:

1. Identify plastic materials and properties.
2. Identify and evaluate characteristics of selected plastic materials.

Please Do Not Write Or Mark On This Guide

(c) El Paso Community College, 1988

LEARNING EXPERIENCES

Performance Enabler No. 1

Identify plastic materials and properties.

LEARNING ACTIVITIES

SPECIAL INSTRUCTIONS

Please Do Not Write Or Mark On This Guide

Read: Industrial Plastics, pp. 65-100,
pp. 143-162.

Read: Injection Molding Handbook,
pp. 683-718.

This reading is on
properties.

This reading deals
with molding mater-
ials.

(c) El Paso Community College, 1988

SELF-CHECK

DIRECTIONS

Please Do Not Write Or Mark On This Guide

To check your knowledge of this lesson, go through Session #2, "Behavior of Plastics," in your workbook. For answers, check with your instructor.

PERFORMANCE TEST

STUDENT'S NAME

DATE

COMPETENCY NUMBER AND STATEMENT

TEST ATTEMPT

Explain application of plastic materials

1ST 2ND 3RD

DIRECTIONS

OVERALL EVALUATION:

PERFORMANCE LEVELS

- 4 Can perform this skill without supervision and with initiative and adaptability to problem situations.
- 3 Can perform this skill satisfactorily without assistance or supervision.
- 2 Can perform this skill satisfactorily but requires some assistance and/or supervision.
- 1 Can perform parts of this skill satisfactorily but requires considerable assistance and/or supervision.
- 0 Cannot perform this skill.

PERFORMANCE STANDARDS

For acceptable achievement, all items should receive a "yes" or "not applicable" response.

	YES	NO	NOT APPL.
Directions: Answer, using your own words:			
1. Define density.			
2. Define viscosity.			
3. What is creep?			
4. What is an impact test?			
(continued...)			

PERFORMANCE TEST (CONT.)

PERFORMANCE STANDARDS

FOR ACCEPTABLE ACHIEVEMENT, ALL ITEMS SHOULD RECEIVE A "YES" OR "NOT APPLICABLE" RESPONSE
YES NO NOT APPL.

- | | | | |
|---|--|--|--|
| 5. What does M.I. stand for? | | | |
| 6. What is the purpose of fillers? | | | |
| 7. What is the purpose of reinforcements? | | | |
| 8. What is the purpose of plasticizers? | | | |
| 9. What is the purpose of stabilizers? | | | |
| 10. What does "U.V. stabilizer" mean? | | | |
| 11. What is the purpose of a blowing agent? | | | |

Please Do Not Write Or Mark On This Guide

LEARNING EXPERIENCES

Performance Enabler No. 2

Identify and evaluate characteristics of selected plastic materials.

LEARNING ACTIVITIES

SPECIAL INSTRUCTIONS

Please Do Not Write Or Mark On This Guide

Read: Industrial Plastics, pp. 163-264.

Read: Injection Molding Handbook,
pp. 501-626

Selected materials can be viewed at
plastics lab. Please ask instructor
for assistance.

These segments deal
with individual
groups of plastic
materials.

(c) El Paso Community College, 1988

PERFORMANCE TEST

STUDENT'S NAME

DATE

COMPETENCY NUMBER AND STATEMENT

Identify and evaluate characteristics of selected plastic materials.

TEST ATTEMPT

1ST 2ND 3RD

DIRECTIONS

OVERALL EVALUATION:

PERFORMANCE LEVELS

- 4 Can perform this skill without supervision and with initiative and adaptability to problem situations.
- 3 Can perform this skill satisfactorily without assistance or supervision.
- 2 Can perform this skill satisfactorily but requires some assistance and/or supervision.
- 1 Can perform parts of this skill satisfactorily but requires considerable assistance and/or supervision.
- 0 Cannot perform this skill.

PERFORMANCE STANDARDS

For acceptable achievement, all items should receive a "yes" or "not applicable" response.

	YES	NO	NOT APPL.
Directions: Name major characteristics of the following thermoplastic materials:			
1. ABS			
2. Nylon			
3. Polycarbonate			
(continued...)			

PERFORMANCE TEST (CONT.)

PERFORMANCE STANDARDS

FOR ACCEPTABLE ACHIEVEMENT, ALL ITEMS SHOULD RECEIVE A "YES" OR "NOT APPLICABLE" RESPONSE
YES NO NOT APPL.

- | | YES | NO | NOT APPL. |
|-------------------|-----|----|-----------|
| 4. Polyethelene | | | |
| 5. Polypropelene | | | |
| 6. PVC | | | |
| 7. Acetate | | | |
| 8. Cellulosics | | | |
| 9. Fluoroplastics | | | |
| 10. Thermosets | | | |

Please Do Not Write Or Mark On This Guide

STUDENT LEARNING GUIDE

**Advanced Industrial Technology Training Center
c/o El Paso Community College
P.O. Box 20500
El Paso, Texas 79998**

COURSE NUMBER AND TITLE: Plastic Materials and Applications

DUTY/UNIT: Processes and Production Methods

COMPETENCY NUMBER: 3

COMPETENCY: IDENTIFY AND DIFFERENTIATE MOLDING PROCESSES

INTRODUCTION:

In this unit you will learn about major production methods and processes used with plastic materials.

PERFORMANCE OBJECTIVE:

Given appropriate instruction, identify and differentiate between different molding processes, such as injection molding, thermoplastics, thermosets, extrusion, and compression molding processes, and vacuum forming. Your performance will be evaluated by your instructor, using the performance checklist.

PERFORMANCE ENABLERS:

1. Identify and differentiate between molding processes.
2. Identify and differentiate between other competitive processes.

Please Do Not Write Or Mark On This Guide

(c) El Paso Community College, 1988

LEARNING EXPERIENCES

Performance Enabler No. 1

Identify and differentiate between molding processes.

LEARNING ACTIVITIES

SPECIAL INSTRUCTIONS

Please Do Not Write Or Mark On This Guide

Read: Industrial Plastics, pp. 285-334

Read: Injection Molding Handbook,
pp. 747-795

(c) El Paso Community College, 1988

PERFORMANCE TEST

STUDENT'S NAME

DATE

COMPETENCY NUMBER AND STATEMENT

TEST ATTEMPT

3 - Identify and differentiate between different molding processes.

1ST 2ND 3RD

DIRECTIONS
(see below)

OVERALL EVALUATION:

PERFORMANCE LEVELS

- 4 Can perform this skill without supervision and with initiative and adaptability to problem situations.
- 3 Can perform this skill satisfactorily without assistance or supervision.
- 2 Can perform this skill satisfactorily but requires some assistance and/or supervision.
- 1 Can perform parts of this skill satisfactorily but requires considerable assistance and/or supervision.
- 0 Cannot perform this skill.

PERFORMANCE STANDARDS

For acceptable achievement, all items should receive a "yes" or "not applicable" response.

	YES	NO	NOT APPL.
Directions: Answer the following items in your own words.			
1. List the phases of a complete injection molding cycle.			
2. Define the injection molding process.			
(Continued...)			

PERFORMANCE TEST (CONT.)

PERFORMANCE STANDARDS

FOR ACCEPTABLE ACHIEVEMENT, ALL ITEMS SHOULD RECEIVE A "YES" OR "NOT APPLICABLE" RESPONSE

YES NO NOT APPL.

- | | | | |
|------------------------------------|--|--|--|
| 3. What is blow molding? | | | |
| 4. What is injection blow molding? | | | |
| 5. What does RIM mean? | | | |
| 6. What is simple cresting? | | | |
| 7. What is the extrusion process? | | | |
| 8. What is vacuum forming? | | | |
| 9. What is transfer molding? | | | |

Please Do Not Write Or Mark On This Guide

LEARNING EXPERIENCES

Performance Enabler No. 2

Identify and differentiate between other competitive processes.

LEARNING ACTIVITIES

SPECIAL INSTRUCTIONS

Please Do Not Write Or Mark On This Guide

Read: Injection Molding Handbook,
pp. 801-817.

Read: Industrial Plastics, pp. 361-516.

(c) El Paso Community College, 1988

OFFICIAL COURSE OUTLINE

Curriculum Title: Plastics Technology

Course Title: Injection Molds and Mold Maintenance

Subject Area Code:

- I. Course Description: The course provides the students with the fundamentals of the different types of injection mold structures, mold materials, and the basics of mold preventive maintenance, including the use of lubricants, greases, rust-preventing compounds, and cleaners.
- II. Course Objectives: Upon satisfactory completion of this course, the students will be able to:
 - A. Identify the different types of injection molds.
 - B. Take apart and put together an injection mold.
 - C. Identify the purpose of different mold steels.
 - D. Identify the various hot-nerves systems.
 - E. Replace damaged and broken parts in a mold.
 - F. Use the proper mold cleaners, mold releases, rust preventives, lubricants and mold protectors.
 - G. Perform mold preventive maintenance, repair mold for short or long-term shelving.
- III. Unit Titles:
 - A. Unit I: Types of Molds

This is an introduction to injection mold design and to the different types of injection molds: two plate injection mold, three plate injection mold, hot-nerve mold.
 - B. Unit II: Mold Materials and Components

Mold and cavity materials, and strength details of molds, mold components, cooling and mold bases are to be discussed.
 - C. Unit III: Mold Maintenance

Involves disassembly and assembly of mold, functions of components, the use of all releases, cleaners, rust preventives and lubricants.

IV. Texts and Materials: (Recommended by Instructor)

- A. Text (To be ordered by students from publishers or purchased at Bookstore)

Joseph B. Dym - Van Nostrand Reinhold: Injection Molds and Molding

D.V. Rosato - Injection Molding Handbook,
Van Nostrand Reinhold Company

- B. Study Aids for Students - Video tapes and related workbooks from Paulson Video Training course

V. Instructors' Resources:

- A. Books: Joseph B. Dym - Van Nostrand Reinhold:
Injection Molds and Molding
- B. Videotapes and related study guide from Paulson
Training Course.

VI. Evaluation Measures

The knowledge and skills stated in the objective must be demonstrated by the students in the form of tests and arrangements in order to complete the course.

Tests and assignments will be averaged and a letter grade will be arranged as follows:

90 - 100 = A
80 - 89 = B
70 - 79 = C
60 - 69 = D
59 or below = F

Students should be able to compute their grade average anytime during the course.

Missed assignments and make-up tests will be given at the discretion of the instructor.

STUDENT LEARNING GUIDE

Advanced Industrial Technology Training Center
c/o El Paso Community College
P.O. Box 20500
El Paso, Texas 79998

COURSE NUMBER AND TITLE: Injection Mold and Mold Maintenance

DUTY/UNIT: Mold Materials and Components

COMPETENCY NUMBER: 1

COMPETENCY: EXPLAIN FUNCTION, COMPONENTS AND CARE OF MOLD

INTRODUCTION:

In this unit you will learn and identify the purpose of injection molds, mold steels, and cavity materials, the components of an injection mold, cooling systems, and mold bases. This learning guide will help you to acquire these skills.

PERFORMANCE OBJECTIVE:

Given appropriate instruction, list the different mold bases, components of molds, mold steels, and cavity materials, and explain how an injection mold works and how it is cooled. Your performance will be evaluated by your instructor, using the performance test checklist.

PERFORMANCE ENABLERS:

1. Identify and demonstrate the components of an injection mold, including mold bases, purpose, and function of molds.
2. Identify different mold steels and cavity materials and their purpose, and the dimensions of mold size and strength.

Please Do Not Write Or Mark On This Guide

(c) El Paso Community College, 1988

LEARNING EXPERIENCES

Performance Enabler No.

Identify and demonstrate the components of an injection mold, including mold bases, purpose, and function of molds.

LEARNING ACTIVITIES

SPECIAL INSTRUCTIONS

Please Do Not Write Or Mark On This Guide

Read: J.B. Dym, Injection Molds and Molding, pp. 16-21.

Read: J.B. Dym, Injection Molds and Molding, pp. 116-138.

To check your knowledge of mold components and their function, view videotape #4 (Paulson Injection Molding Technology) "Injection Molds," for parts and function of mold.

Arrange with your instructor to discuss and review your paper with you.

(c) El Paso Community College, 1988

SELF-CHECK

DIRECTIONS

Identify the following mold components.

Please Do Not Write Or Mark On This Guide

- | | |
|----------|-----------|
| 1. _____ | 9. _____ |
| 2. _____ | 10. _____ |
| 3. _____ | 11. _____ |
| 4. _____ | 12. _____ |
| 5. _____ | 13. _____ |
| 6. _____ | 14. _____ |
| 7. _____ | 15. _____ |
| 8. _____ | 16. _____ |
-
-

(c) El Paso Community College, 1988

PERFORMANCE TEST

STUDENT'S NAME

DATE

COMPETENCY NUMBER AND STATEMENT

1: Explain function, components, care

TEST ATTEMPT

1ST 2ND 3RD

DIRECTIONS
(See below)

OVERALL EVALUATION:

PERFORMANCE LEVELS

- 4 Can perform this skill without supervision and with initiative and adaptability to problem situations.
- 3 Can perform this skill satisfactorily without assistance or supervision.
- 2 Can perform this skill satisfactorily but requires some assistance and/or supervision.
- 1 Can perform parts of this skill satisfactorily but requires considerable assistance and/or supervision.
- 0 Cannot perform this skill.

PERFORMANCE STANDARDS

For acceptable achievement, all items should receive a "yes" or "not applicable" response.

	YES	NO
Directions: Your instructor will assign a mold to you, with which you must demonstrate and explain the parts and functions of molds. Your instructor will observe and evaluate your performance using the performance test checklist.		
Identify in Plastics lab the following components of an injection mold:		
1. Ejector pins		
2. Spine bushing		
3. Spine puller		
4. Water lines for cooling		
(Continued)		

PERFORMANCE TEST (CONT.)

PERFORMANCE STANDARDS

FOR ACCEPTABLE ACHIEVEMENT, ALL ITEMS SHOULD RECEIVE A "YES" OR "NOT APPLICABLE" RESPONSE
YES NO NOT APPL.

- | | YES | NO | NOT APPL. |
|----------------------------|-----|----|-----------|
| 5. Ejector plate | | | |
| 6. Cavity insert | | | |
| 7. Ejector housing | | | |
| 8. Core insert | | | |
| 9. Ejector retainer plate | | | |
| 10. Clamping plate (2) | | | |
| 11. Support plate | | | |
| 12. Supporting pillar | | | |
| 13. Stop pin | | | |
| 14. Front cavity plate | | | |
| 15. Rear cavity plate | | | |
| 16. Locating ring | | | |
| 17. Leader pins | | | |
| 18. Leader pin bushing | | | |
| 19. Return pin | | | |
| 20. Spacer block | | | |
| 21. Front cavity plate "A" | | | |
| 22. Front cavity plate "B" | | | |

Please Do Not Write Or Mark On This Guide

LEARNING EXPERIENCES

Performance Enabler No. 2

Identify mold steels and construction materials and their purpose, and mold size and strength.

LEARNING ACTIVITIES

SPECIAL INSTRUCTIONS

Please Do Not Write Or Mark On This Guide	
---	--

Read: J.B. Dym, Injection Molds and Molding, pp. 40-70.

This segment is on size and strength.

Read: J.B. Dym, Injection Molds and Molding, pp. 144-172

This segment is on core materials.

(c) El Paso Community College, 1988

SELF-CHECK

DIRECTIONS

Check your knowledge by listing cavity materials, steels, and size of mold bases and supports.

Please Do Not Write Or Mark On This Guide

1. List at least three different cavity materials and their purpose.

2. Name the three grades of steel used in mold bases.

3. Define the necessary size and strength of a cavity.

(c) El Paso Community College, 1988

PERFORMANCE TEST

STUDENT'S NAME

DATE

COMPETENCY NUMBER AND STATEMENT

TEST ATTEMPT

1. Explain mold function, components, care.

1ST 2ND 3RD

DIRECTIONS

See below

OVERALL EVALUATION:

PERFORMANCE LEVELS

- 4 Can perform this skill without supervision and with initiative and adaptability to problem situations.
- 3 Can perform this skill satisfactorily without assistance or supervision.
- 2 Can perform this skill satisfactorily but requires some assistance and/or supervision.
- 1 Can perform parts of this skill satisfactorily but requires considerable assistance and/or supervision.
- 0 Cannot perform this skill.

PERFORMANCE STANDARDS

For acceptable achievement, all items should receive a "yes" or "not applicable" response.

Answer the following questions in the presence of your instructor:

A. Define three properties of hardness.

1. _____

2. _____

3. _____

(Continued...)

PERFORMANCE TEST (CONT.)

PERFORMANCE STANDARDS

FOR ACCEPTABLE ACHIEVEMENT, ALL ITEMS SHOULD RECEIVE A "YES" OR "NOT APPLICABLE" RESPONSE

YES NO NOT APPL.

B. Name three of the basic seven tool steels.

4. _____

5. _____

6. _____

C. Name three steel formulations for plastics.

7. _____

8. _____

9. _____

Please Do Not Write Or Mark On This Guide

STUDENT LEARNING GUIDE

Advanced Industrial Technology Training Center
c/o El Paso Community College
P.O. Box 20500
El Paso, Texas 79998

COURSE NUMBER AND TITLE: Injection Molds and Mold Maintenance

DUTY/UNIT: Mold Maintenance

COMPETENCY NUMBER: 2

COMPETENCY: DEMONSTRATE CARE AND MAINTENANCE OF MOLD

INTRODUCTION:

In this unit you will take apart and assemble a mold. You will examine and analyze the mold components, diagnose malfunctions and learn how to take care of a mold while it is running and how to use preventive maintenance.

PERFORMANCE OBJECTIVE:

Given a working mold, demonstrate and explain the injection mold "at work." Take a mold apart, change K.O. pins if needed; do cleaning, basic polishing, lubricating; use other preventive maintenance functions.

PERFORMANCE ENABLERS:

1. Describe mold set-up principles, then take apart and assemble a mold.
2. Examine the mold and perform the necessary maintenance.

Please Do Not Write Or Mark On This Guide

(c) El Paso Community College, 1988

LEARNING EXPERIENCES

Performance Enabler No. 1

Describe mold set-up principles, then take apart and assemble a mold.

LEARNING ACTIVITIES

SPECIAL INSTRUCTIONS

Please Do Not Write Or Mark On This Guide

Read: Injection Molds and Molding,
pp. 81-82.

This segment deals
with eyebolt holes
and clamp tonnage.

Read: Injection Molds and Molding,
pp. 289-297

This is about mold
set-up.

With your instructor's permission and
supervision, take a mold apart and ex-
amine the function of its components;
assemble the mold.

(c) El Paso Community College, 1988

SELF-CHECK

DIRECTIONS

Appraise your progress by answering the following questions.

Please Do Not Write Or Mark On This Guide

1. Forged steel eyebolts have a load-carrying capacity. Name the three basic capacities and the sizes of eyebolts.
2. How does one establish the minimum square inch area of the mold base that will safely absorb the clamp force?
3. Examine how a mold functions in plastic lab, and identify functions of components.
4. Demonstrate mold set-up principles in plastic lab.

PERFORMANCE TEST

STUDENT'S NAME

DATE

COMPETENCY NUMBER AND STATEMENT

TEST ATTEMPT

2 - Demonstrate care and maintenance
of mold.

1ST 2ND 3RD

DIRECTIONS
(see below)

OVERALL EVALUATION:

PERFORMANCE LEVELS

- 4 Can perform this skill without supervision and with initiative and adaptability to problem situations.
- 3 Can perform this skill satisfactorily without assistance or supervision.
- 2 Can perform this skill satisfactorily but requires some assistance and/or supervision.
- 1 Can perform parts of this skill satisfactorily but requires considerable assistance and/or supervision.
- 0 Cannot perform this skill.

PERFORMANCE STANDARDS

For acceptable achievement, all items should receive a "yes" or "not applicable" response.

	YES	NO	NOT APPL.
Directions: Write your answer to the following questions:			
1. Name the three modes of operation of a molding machine.			
A.			
B.			
C.			
(Continued...)			

PERFORMANCE TEST (CONT.)

PERFORMANCE STANDARDS

FOR ACCEPTABLE ACHIEVEMENT, ALL ITEMS SHOULD RECEIVE A "YES" OR "NOT APPLICABLE" RESPONSE
YES NO NOT APPL.

- | | | | |
|---|--|--|--|
| 2. A molding machine has three modes of operation. In semi-automatic mode, the molding machine will: (Circle one)
A-Use a robot to remove parts.
B-Stop cycling when the mold opens.
C-Continue cycling until the safety gate is opened. | | | |
| 3. If a molding machine is operating in the automatic mode and you want to quickly stop it from cycling, you could open the safety gate.
A-True.
B-False. | | | |
| 4. In the manual mode of operation, the molding machine
A-Stops cycling when the mold opens.
B-Control settings are made by computer.
C-Requires the operator to initiate all phases of the molding cycle. | | | |
| 5. In an emergency, the machine can be stopped immediately by
A-Opening the safety gate.
B-Pushing the red emergency button.
C-Calling the foreman. | | | |
| 6. Identify in plastics lab, in the presence of the instructor, the following components of an injection molding machine:
A-The box
B-Hopper
C-Clamp cylinders
D-Heater band on barrel. | | | |
| 7. Take apart and assemble a mold in the presence of your instructor. | | | |

(Continued...)

Please Do Not Write Or Mark On This Guide

PERFORMANCE TEST (CONT.)

PERFORMANCE STANDARDS

FOR ACCEPTABLE ACHIEVEMENT, ALL ITEMS SHOULD RECEIVE A "YES" OR "NOT APPLICABLE" RESPONSE
YES NO NOT APPL.

- | | | | |
|---|--|--|--|
| 8. What is the function of the locating ring? | | | |
| 9. What is the function of the ejector pin? | | | |
| 10. What is the function of the leader pin? | | | |
| 11. The core of a mold is usually put in the movable half of a mold because of
A-Cooling.
B-Better packing.
C-Ejection.
D-Costing less. | | | |
| 12. What is the purpose of the maner system? | | | |

Please Do Not Write Or Mark On This Guide

LEARNING EXPERIENCES

Performance Enabler No. 2

Examine a mold and perform the necessary maintenance.

LEARNING ACTIVITIES

SPECIAL INSTRUCTIONS

Please Do Not Write Or Mark On This Guide

Read: Injection Molding Handbook,
pp. 216-220.

Read: Injection Molding Handbook,
pp. 222-233.

Read: Injection Molds and Molding,
pp. 289-297.

Do a practical analysis of mold re-
leases, cleaners, rust preventatives,
and lubricants.

The instructor will
have handouts on
this subject and
discuss proper use.

(c) El Paso Community College, 1988

SELF-CHECK

DIRECTIONS

A good molded part, among other factors, is a product of mold design, mold set-up, and mold maintenance. We are focusing on the mold maintenance factor. For the above reasons, go through mold placement and mold removal processes. Also, describe mold examination steps for the checklist below.

Please Do Not Write Or Mark On This Guide

1. Ejector system:
2. Vents:
3. Cavity and Core:
4. Cooling Channels:
5. Cam Action:
6. Spine Bushing:
7. Heaters:
8. Lubrication:
9. Storage:

Write below the functions of the different mold releases, cleaners, rust preventatives, and lubricants:

- 10.
 - 11.
 - 12.
 - 13.
 - 14.
-
-

PERFORMANCE TEST

STUDENT'S NAME

DATE

COMPETENCY NUMBER AND STATEMENT

TEST ATTEMPT

2 - Demonstrate and explain the care and maintenance of molds.

1ST 2ND 3RD

DIRECTIONS
(see below)

OVERALL EVALUATION:

PERFORMANCE LEVELS

- 4 Can perform this skill without supervision and with initiative and adaptability to problem situations.
- 3 Can perform this skill satisfactorily without assistance or supervision.
- 2 Can perform this skill satisfactorily but requires some assistance and/or supervision.
- 1 Can perform parts of this skill satisfactorily but requires considerable assistance and/or supervision.
- 0 Cannot perform this skill.

PERFORMANCE STANDARDS

For acceptable achievement, all items should receive a "yes" or "not applicable" response.

	YES	NO	NOT APPL.
Directions: Answer the following questions. Your instructor will observe and evaluate your performance using the performance checklist.			
Molds that run about 200,000 cycles should be subject to a more thorough examination. Some suggested areas are listed below; other areas depend on your judgment.			
Of course, the schedule for this inspection can vary, depending on the nature of			
(Continued...)			

PERFORMANCE TEST (CONT.)

PERFORMANCE STANDARDS

FOR ACCEPTABLE ACHIEVEMENT, ALL ITEMS SHOULD RECEIVE A "YES" OR "NOT APPLICABLE" RESPONSE
YES NO NOT APPL.

materials and other conditions. The performance of the mold would dictate the examination.

For that reason, the following should be examined and repaired on a mold if necessary, or lubricated as the tool requires.

After the listed items, write the performance to be done in that area.

1. Cams
2. Spine Bushing
3. Cooling Channel
4. Vents
5. Ejection System
6. Cavity and Core
7. List performance needed to prepare a mold for long-term shelving.
8. Explain use and function of lubrication.
9. Explain function and use of mold release.

(Continued...)

Please Do Not Write Or Mark On This Guide

PERFORMANCE TEST (CONT.)

PERFORMANCE STANDARDS

FOR ACCEPTABLE ACHIEVEMENT, ALL ITEMS SHOULD RECEIVE A "YES" OR "NOT APPLICABLE" RESPONSE
YES NO NOT APPL.

- | | | | |
|--|--|--|--|
| 10. Explain the function and use of rust preventative. | | | |
| 11. Explain the function and use of mold protector. | | | |

Please Do Not Write Or Mark On This Guide

OFFICIAL COURSE OUTLINE

Subject Area Title: Plastics Technology
Course Title: Injection Molding Machine Operation
Subject Area Code:

I. Catalog Description

This course introduces the injection molding machine, including its concepts, controls, and operation.

II. Course Objectives

Upon successful completion of this course, the student will be able to:

- A. Identify different injection plasticating systems.
- B. Describe molding machine functions and controls.
- C. Describe hydraulic circuit principle.
- D. Describe electrical circuit principles.
- E. Identify and describe the various clamping concepts.
- F. Identify basic maintenance and service needs.
- G. Operate an injection molding machine.

III. Unit Titles

- A. Unit I — The Injection Molding Operation. This unit introduces the injection molding environment: equipment, molding materials, production control, and quality.
- B. Unit II — The Injection Molding Machine. This unit introduces the different types of machines, concepts, and machine operations.

IV. Texts and Materials (recommended by instructor)

- A. Texts (to be ordered by students from publishers or purchased at bookstore).

Injection Molds and Molding, J. B. Dym, Van Nostrand Reinhold Co.

Injection Molding Handbook, D. V. Rosato, Van Nostrand Reinhold Co.

- B. Study Aids for Students:

Videotapes and related workbooks.

V. Instructor's Resources

(See above.)

VI. Evaluation Measures

The skills and knowledge for identification and demonstration as stated in the objectives will be evaluated by assignments and tests. These performances will be averaged, and a letter grade will be assigned as follows:

90 - 100	A
80 - 89	B
70 - 79	C
60 - 69	D
0 - 59	F

Students will be able to compute their grade average anytime during the course. Missed assignments and make-up tests will be given at the discretion of the instructor.

STUDENT LEARNING GUIDE

**Advanced Industrial Technology Training Center
c/o El Paso Community College
P.O. Box 20500
El Paso, Texas 79998**

COURSE NUMBER AND TITLE: Injection Molding Machine

DUTY/UNIT: Injection Molding Machine Operation

COMPETENCY NUMBER: 1

**COMPETENCY: ASSESS THE STRUCTURE, MATERIAL AND EQUIPMENT
NEEDED FOR AN INJECTION MOLDING MACHINE**

INTRODUCTION:

In this unit you will learn about a typical injection molding factory and how it operates, including production control, quality control, equipment, and safety standards. This learning guide will help you to achieve the stated objectives.

PERFORMANCE OBJECTIVE:

Given appropriate instruction, assess the structure, material, and equipment needed for an injection molding machine.

PERFORMANCE ENABLERS:

1. Identify the purpose and structure of molding operations.

Please Do Not Write Or Mark On This Guide

LEARNING EXPERIENCES

Performance Enabler No. 1

Identify the components of an injection molding machine.

LEARNING ACTIVITIES

SPECIAL INSTRUCTIONS

Please Do Not Write Or Mark On This Guide

Read: Injection Molding Handbook,
pp. 39-55.

Read: Injection Molding Handbook,
pp. 56-81.

View: Video tape #3 from Paulson tapes.

This is about injection and clamping systems.

This segment deals with the plasticating process.

This videocassette is about the injection molding machine parts, functions and concepts.

(c) El Paso Community College, 1988

SELF-CHECK

DIRECTIONS

See below.

Please Do Not Write Or Mark On This Guide

1. To check your knowledge, you should be able to list the basic equipment needed for an injection molding factory:

2. List the OSHA safety color codes.

- | | |
|----|----|
| a. | e. |
| b. | f. |
| c. | |
| d. | |

PERFORMANCE TEST

STUDENT'S NAME

DATE

COMPETENCY NUMBER AND STATEMENT

TEST ATTEMPT

- 1 - Assess structure, materials and equipment needed for an injection molding operation.

1ST 2ND 3RD

DIRECTIONS

(See below)

OVERALL EVALUATION:

PERFORMANCE LEVELS

- 4 Can perform this skill without supervision and with initiative and adaptability to problem situations.
- 3 Can perform this skill satisfactorily without assistance or supervision.
- 2 Can perform this skill satisfactorily but requires some assistance and/or supervision.
- 1 Can perform parts of this skill satisfactorily but requires considerable assistance and/or supervision.
- 0 Cannot perform this skill.

PERFORMANCE STANDARDS

For acceptable achievement, all items should receive a "yes" or "not applicable" response.

	YES	NO	NOT APPL.
Directions: In the presence of your instructor, please answer the questions on this test. Your instructor will observe and evaluate your performance using the performance test checklist.			
1. What does OSHA stand for?			
2. What do the following color codes mean?			
(Continued...)			

PERFORMANCE TEST (CONT.)

PERFORMANCE STANDARDS

FOR ACCEPTABLE ACHIEVEMENT, ALL ITEMS SHOULD RECEIVE A "YES" OR "NOT APPLICABLE" RESPONSE

YES NO NOT APPL.

a. red			
b. orange			
c. yellow			
d. green			
e. blue			
f. purple			
g. black/white			
3. What is the basic injection molding process?			
a. .			
b.			
c.			

Please Do Not Write Or Mark On This Guide

LEARNING EXPERIENCES

Performance Enabler No. 2

- Identify controls and functions of an injection molding machine.

LEARNING ACTIVITIES

SPECIAL INSTRUCTIONS

Please Do Not Write Or Mark On This Guide

Read: Injection Molding Handbook,
pp. 84-111.

View: Video tape #5 from Paulson tapes.

Activity: Ask your instructor to review
(in plastics lab) each phase and control
of the machine. Run the machine in a
cycle in the presence of the instructor.

This segment will
teach you how to
operate a machine.

This tape describes
the purpose of each
control and its
operation.

(c) El Paso Community College, 1988

PERFORMANCE TEST

STUDENT'S NAME

DATE

COMPETENCY NUMBER AND STATEMENT

TEST ATTEMPT

2 - List components, controls, and functions of injection molding machine.

1ST 2ND 3RD

DIRECTIONS
(See below)

OVERALL EVALUATION:

PERFORMANCE LEVELS

- 4 Can perform this skill without supervision and with initiative and adaptability to problem situations.
- 3 Can perform this skill satisfactorily without assistance or supervision.
- 2 Can perform this skill satisfactorily but requires some assistance and/or supervision.
- 1 Can perform parts of this skill satisfactorily but requires considerable assistance and/or supervision.
- 0 Cannot perform this skill.

PERFORMANCE STANDARDS

For acceptable achievement, all items should receive a "yes" or "not applicable" response.

	YES	NO	NOT APPL.
Directions: In the presence of your instructor, please answer the following questions:			
1. The typical hydraulic pressure for a molding machine is:			
a. 5000 psi			
b. 1000 psi			
c. 2000 psi			
d. 10,000 psi			
(Continued...)			

PERFORMANCE TEST (CONT.)

PERFORMANCE STANDARDS

FOR ACCEPTABLE ACHIEVEMENT, ALL ITEMS SHOULD RECEIVE A "YES" OR "NOT APPLICABLE" RESPONSE
YES NO NOT APPL.

- | | | | |
|--|--|--|--|
| 2. What are the three zones of a plasticating screw? | | | |
| 3. The main purpose of a vented barrel is:
a. to increase shot size
b. to remove moisture and gases from material.
c. to increase molding capacity. | | | |
| 4. Which timer should be set to fill and pack the mold? | | | |
| 5. What are the three hydraulic pressures for an injection molding machine?
a.
b.
c. | | | |
| 6. What is the function of the high volume pump? | | | |
| 7. What is the function of the low volume pump? | | | |
| 8. The function of the front zone temperature control is: | | | |
| 9. On a plasticating screw, why does the feed zone have the deepest flights? | | | |

(Continued...)

Please Do Not Write Or Mark On This Guide

PERFORMANCE TEST

STUDENT'S NAME

DATE _____

COMPETENCY NUMBER AND STATEMENT

TEST ATTEMPT

1ST 2ND 3RD

DIRECTIONS

OVERALL EVALUATION:

PERFORMANCE LEVELS

- 4 Can perform this skill without supervision and with initiative and adaptability to problem situations.
- 3 Can perform this skill satisfactorily without assistance or supervision.
- 2 Can perform this skill satisfactorily but requires some assistance and/or supervision.
- 1 Can perform parts of this skill satisfactorily but requires considerable assistance and/or supervision.
- 0 Cannot perform this skill.

PERFORMANCE STANDARDS

For acceptable achievement, all items should receive a "yes" or "not applicable" response.

	YES	NO	NOT APPL.

PERFORMANCE TEST (CONT.)

PERFORMANCE STANDARDS

FOR ACCEPTABLE ACHIEVEMENT, ALL ITEMS SHOULD RECEIVE A "YES" OR "NOT APPLICABLE" RESPONSE
YES NO NOT APPL.

- | | | | |
|---|--|--|--|
| 10. The maximum amount of plastic that can be injected with one full stroke of the screw is called:

a. port size
b. volume size
c. shot size | | | |
| 11. In the semi-auto mode, the injection molding machine will:

a. continue cycling until the operator stops the machine
b. require that all phases of the cycle be done by the operator
c. stop cycling when the mold opens. | | | |
| 12. If a plasticating screw has an L/D ratio of 15/1 and the diameter is 2 inches, the screw length should be:

a. 3 in
b. 6 in
c. 60 in
d. 30 in | | | |
| 13. What are the three modes of operation of an injection molding machine?

a.
b.
c. | | | |
| 14. The purpose of the non-return valve is: | | | |

(Continued...)

Please Do Not Write Or Mark On This Guide

PERFORMANCE TEST (CONT.)

PERFORMANCE STANDARDS

FOR ACCEPTABLE ACHIEVEMENT, ALL ITEMS SHOULD RECEIVE A "YES" OR "NOT APPLICABLE" RESPONSE

YES NO NOT APPL.

15. The melting or plasticating capacity of a molding machine is:

- a. a measurement by continuous rotation of screw
- b. the total weight of a shot
- c. the weight of the parts that the machine can produce in one hour
- d. none of the above

Please Do Not Write Or Mark On This Guide

OFFICIAL COURSE OUTLINE

Curriculum Title: Plastic Technology
Course Title: Injection Molding Process Control
and Troubleshooting
Subject Area Code:

I. Course Description

This course provides an analysis of molding problems, their solutions, and process controlling.

II. Course Objectives

Upon satisfactory completion of this course, the student will be able to:

- A. Differentiate between open and closed loop process control devices.
- B. Correct and monitor machine operation.
- C. Explain the importance of repeatability in machine operation.
- D. Explain clearly the difference between "monitoring" and "controlling."
- E. "Troubleshoot" molding problems such as:
 - 1. Weld line
 - 2. Void
 - 3. Burn mark
 - 4. Warp
 - 5. Flow marks
 - 6. Glossiness

(Continued...)

7. Discoloration
8. Jetting
9. Short shot
10. Sink marks
11. Flexing
12. Lamination
13. Part sticking

III. Unit Titles

- A. Unit I — Process Control Technology. This unit introduces various process controls and devices.
- B. Unit II — Troubleshooting. This unit reviews previous work and shows how to define the problem, how to define the solution, and then how to determine the variable that should correct the problem.

IV. Texts and Materials

- A. Texts (available from publisher or at bookstore)

Injection Molding Handbook, D. V. Rosato, Van Nostrand Reinhold Company.

Injection Molds and Molding, J. B. Dym, Van Nostrand Reinhold Company.

- B. Study Aids for Students:

1. Videotapes: Injection Molding Technology (Paulson Video Training course), workbook, and study guide specifically for the subject.
2. Hands-on technical experience in Plastics Lab in the presence of the instructor or of the instructor's assistant.

(Continued...)

V. Instructor's Resources

A. Books:

Injection Molds and Molding, J. B. Dym, Van Nostrand Reinhold Company.

Injection Molding Handbook, D. V. Rosato, Van Nostrand Reinhold Company.

B. Videotapes and instructor's manual from Paulson Tapes.

VI. Evaluation Measures

The skills stated in the course objectives must be demonstrated by the students in the form of tests and assignments in order to successfully complete this course.

Tests and assignments will be averaged, and a letter grade will be assigned as follows:

90 - 100	A
80 - 89	B
70 - 79	C
60 - 69	D
0 - 59	F

Students should be able to compute their grade average anytime during the course.

Missed assignments and make-up tests will be given at the discretion of the instructor.

STUDENT LEARNING GUIDE

**Advanced Industrial Technology Training Center
c/o El Paso Community College
P.O. Box 20500
El Paso, Texas 79998**

**COURSE NUMBER AND TITLE: Injection Molding Process Control
and Troubleshooting**

DUTY/UNIT: Process Control Technology

COMPETENCY NUMBER: 1

COMPETENCY: DIAGNOSE AND TROUBLESHOOT MOLDING PROBLEMS

INTRODUCTION:

In this unit you will review past material and learn the various process controlling methods and devices as part of process control technology. The learning guide will help you, step by step, to acquire these skills.

PERFORMANCE OBJECTIVE:

Given appropriate instruction, list the various functions of process controlling devices and their purpose, and relate product performance to process control via molding parameters.

PERFORMANCE ENABLERS:

1. Demonstrate an understanding of process control.
2. Demonstrate techniques for process control.

Please Do Not Write Or Mark On This Guide

LEARNING EXPERIENCES

Performance Enabler No. 1

Demonstrate an understanding of process control.

LEARNING ACTIVITIES

SPECIAL INSTRUCTIONS

Please Do Not Write Or Mark On This Guide

Read: Injection Molding Handbook,
pp. 277-289

View: Injection Molding Technology
(Paulson Videotape Seminar), Tape #7
and Tape #13.

Review: Related study guides and work-
book sessions #7 - #13.

This is about
process control and
related topics.

Tape #7 is about ef-
ficiency and repeat-
ability. Tape #13
deals with measure-
ment methods.

(c) El Paso Community College, 1988

LEARNING EXPERIENCES

Performance Enabler No. 2

Demonstrate technique for process control.

LEARNING ACTIVITIES

SPECIAL INSTRUCTIONS

Please Do Not Write Or Mark On This Guide

Read: Injection Molding Handbook,
pp. 289-313.

View: Injection Molding Technology
(Paulson Videotape Seminar), Tape #14.

Review: Related study guides and work-
books (#14).

In this segment you
will learn the ad-
vantages of a micro-
processor through
Fill-Pack-Hold and
plastication.

This tape is an ana-
lysis of open and
closed loop systems.

(c) El Paso Community College, 1988

STUDENT LEARNING GUIDE

**Advanced Industrial Technology Training Center
c/o El Paso Community College
P.O. Box 20500
El Paso, Texas 79998**

**COURSE NUMBER AND TITLE: Injection Molding Process Control
and Troubleshooting**

DUTY/UNIT: Troubleshooting

COMPETENCY NUMBER: 2

COMPETENCY: IDENTIFY AND CORRECT PROBLEMS IN MOLD OPERATION

INTRODUCTION:

In this unit you will learn how to solve molding problems using molding technology methods. You will analyze various molded part defects and imperfections and will choose the necessary adjustment based on material behavior and economic considerations.

PERFORMANCE OBJECTIVE:

Given appropriate instruction and laboratory practice, identify the cause of molding problems and define the solution and the step-by-step adjustments, in their respective order, needed to correct the variable.

PERFORMANCE ENABLERS:

1. Identify the cause, effect and solution of various sample problems.
2. Troubleshoot molded part defects.

Please Do Not Write Or Mark On This Guide

LEARNING EXPERIENCES

Performance Enabler No. 1

Identify the cause, effect, and solution of various sample problems.

LEARNING ACTIVITIES

SPECIAL INSTRUCTIONS

Please Do Not Write Or Mark On This Guide

Read: Injection Molds and Molding,
pp. 298-312.

View: Injection Molding Technology
(Paulson Videotape Seminar), Tapes
#8, #9, and #10.

Review: Workbook and study guide from
Paulson Videotape Seminar, Sessions
#8, #9, and #10.

These tapes deal
with the post mold-
ing behavior of the
part.

LEARNING EXPERIENCES

Performance Enabler No. 2

Troubleshoot molded part defects.

LEARNING ACTIVITIES

SPECIAL INSTRUCTIONS

Please Do Not Write Or Mark On This Guide

Read: Injection Molding Handbook,
pp. 659-682.

View: Injection Molding Technology
(Paulson Videotape Seminar), Tapes
#11 and #12.

Review: Workbook and study guide for
Sessions #11 and #12.

Ask your instructor to assist you in
practical experience of examining and
reviewing parts with problems such as
warp, jetting, etc.

This segment follows
up on the previous
one and deals with
molding problems and
solutions.

By viewing these
tapes you will learn
about process vari-
ables such as fill
rate, cooling rate,
and material temper-
ature; also, you
will see defects on
actual parts and
the solutions to the
problems.

SELF-CHECK

DIRECTIONS

Answer "YES" or "NO" to the following questions.

Please Do Not Write Or Mark On This Guide

YES

NO

1. The viscosity of a thermoplastic will change if the pressure is changed.
2. With a temperature change, the electrical resistance of a metal wire also changes.
3. Injection pressure may be increased for a short shot.
4. The mold may be polished for a sink mark.
5. Mold pressure may be decreased for a sink mark.
6. If a molded part is flashing, the injection pressure may be decreased.
7. If there are flow lines, back pressure may be increased.
8. For a short shot, screw feed may be increased.
9. If the melting temperature is too high, the cooling time may be shortened.
10. If there are voids in parts, the nozzle pressure may be increased.
11. If the runner breaks, the sprue may be polished.
12. If there is burning on the part, more vents may be provided in the mold.

(Continued...)

(c) El Paso Community College, 1988

SELF-CHECK (CONT.)

YES

NO

13. If the nozzle is drooling, screw rpm may be increased.
14. If the nozzle is drooling, there may be a broken shutoff valve.
15. For laminations, uncontaminated material may be used.
16. For cooling problems, the mold may be cooled more slowly.
17. Jelling problems are caused by the material forming a flow front.
18. Surface ripples are usually caused by the plastic flow speed being too slow.
19. Molecular orientation can cause cracking at the gate area.
20. If the stress on a molded part exceeds its strength, the part will break.
- 21.-If a molded part is warped, the mold temperature can be changed.

SELF-CHECK ANSWERS

Check your answers. If you need clarification or explanation, please see your instructor.

1. Yes 2. Yes 3. Yes 4. No 5. Yes 6. Yes 7. Yes
8. Yes 9. Yes 10. No 11. Yes 12. Yes 13. No
14. No 15. Yes 16. No 17. No 18. Yes 19. Yes
20. Yes 21. Yes

PERFORMANCE TEST

STUDENT'S NAME

DATE

COMPETENCY NUMBER AND STATEMENT

TEST ATTEMPT

2 - Identify and correct molding problems.

1ST 2ND 3RD

DIRECTIONS
(See below)

OVERALL EVALUATION:

PERFORMANCE LEVELS

- 4 Can perform this skill without supervision and with initiative and adaptability to problem situations.
- 3 Can perform this skill satisfactorily without assistance or supervision.
- 2 Can perform this skill satisfactorily but requires some assistance and/or supervision.
- 1 Can perform parts of this skill satisfactorily but requires considerable assistance and/or supervision.
- 0 Cannot perform this skill.

PERFORMANCE STANDARDS

For acceptable achievement, all items should receive a "yes" or "not applicable" response.

Directions: This test has two phases. #1 is a written test, where you will answer the following questions on these sheets in the presence of your instructor. In phase #2 you will have to overcome (troubleshoot) actual problems in plastics lab, which will be set up and observed by your instructor. Your performance will be evaluated by the combination of the results of these two tests.

(Continued...)

YES	NO	NOT APPL.

PERFORMANCE TEST (CONT.)

PERFORMANCE STANDARDS

FOR ACCEPTABLE ACHIEVEMENT, ALL ITEMS SHOULD RECEIVE A "YES" OR "NOT APPLICABLE" RESPONSE
YES NO NOT APPL.

Directions: Give your answer — yes or no — to the following molding problems as your recommendation to solve the particular problem.

<u>PART</u>	<u>PROBLEM</u>	<u>RECOMMENDED SOLUTION</u>
1.	Flash	lower injection pressure
2.	Silver streaks	dry material
3.	Burns	raise melt temperature
4.	Oversized part	raise injection speed
5.	Oversized part	lower injection speed
6.	Short shot	check cushion
7.	Weld line	raise injection speed
8.	Weld line	raise mold temperature
9.	Undersized - part	raise injection speed
10.	Sprue sticking	lower mold temperature
11.	Part warps	check mold temperature
12.	Dull surface	increase stock temperature.

Name the four most important process variables:

- 13.
- 14.
- 15.
- 16.

17. What is the meaning of "open loop" machine sequence control?

(Continued...)

PERFORMANCE TEST (CONT.)

PERFORMANCE STANDARDS

FOR ACCEPTABLE ACHIEVEMENT, ALL ITEMS SHOULD RECEIVE A "YES" OR "NOT APPLICABLE" RESPONSE

YES NO NOT APPL.

18. What is the meaning of "closed loop" machine sequence?

Troubleshoot the molding problems in plastics lab as they have been set up by your instructor.

19.

20.

21. -

Please Do Not Write Or Mark On This Guide

OFFICIAL COURSE OUTLINE

Subject Area: Plastics Technology

Course Title: Auxiliary Equipment and
Material Handling

Subject Area Code:

I. Catalog Description

This course introduces the various types of auxiliary equipment and material conveying systems that are essential or necessary in a molding plant.

II. Course Objective

Upon successful completion of the course, the student will be able to:

Identify and differentiate between the types of auxiliary equipment used to maximize overall plant efficiency and productivity, such as:

1. Quick mold charge
2. Dryers
3. Hoppers
4. Blenders
5. Filters
6. Pneumatic conveying
7. Material storage
8. Tank trucks and rail car unloading
9. Powder pump
10. Granulating
11. Air movers

(Continued...)

12. Chilled and heated

13. Basic robotics

III. Unit Titles

Unit I - Overview of Auxiliary Equipment. This is an overview of the many different types of equipment and their function.

Unit II - Material Handling. This unit introduces everything that is necessary to automatically supply an injection machine at work.

Unit III - Water-chilling and Recovery Equipment. This unit introduces water-recovery equipment and water management.

IV. Text and Materials

A. Text (to be ordered by students from publisher or purchased at bookstore):

Injection Molding Handbook, D. V. Rosato, Van Nostrand Reinhold Company.

B. Study Aids for Students:

1. Instructor handouts

2. Videotape

V. Instructor's Resources

(See above.)

VI. Methods of Evaluation

Student knowledge and progress will be evaluated by assignments and tests. These performances will be averaged, and a letter grade will be assigned as follows:

(Continued...)

90 - 100	A
80 - 89	B
70 - 79	C
60 - 69	D
0 - 59	F

Students will be able to compute their grade average at any time during the course. Missed assignments and make-up tests will be given at the discretion of the instructor.

STUDENT LEARNING GUIDE

**Advanced Industrial Technology Training Center
c/o El Paso Community College
P.O. Box 20500
El Paso, Texas 79998**

COURSE NUMBER AND TITLE: Auxiliary Equipment and Material Handling

DUTY/UNIT: Overview of Auxiliary Equipment

COMPETENCY NUMBER: 1

COMPETENCY: IDENTIFY FUNCTIONS OF AUXILIARY EQUIPMENT

INTRODUCTION:

In this unit you will achieve an overview of the many different types of auxiliary equipment that are being used in an injection molding plant.

PERFORMANCE OBJECTIVE:

Given appropriate instruction, identify the purpose and basic function of auxiliary equipment related to a plastics operation.

PERFORMANCE ENABLERS:

1. Select auxiliary equipment for greatest efficiency.
2. Demonstrate knowledge of what equipment and what systems are available for use in molding plants.

Please Do Not Write Or Mark On This Guide

LEARNING EXPERIENCES

Performance Enabler No. 1

Select auxiliary equipment for greatest efficiency.

LEARNING ACTIVITIES

SPECIAL INSTRUCTIONS

Please Do Not Write Or Mark On This Guide

Read: Injection Molding Handbook,
pp. 385-391.

View: Videotape on auxiliary equipment.

This is an overview
of the subject.

(c) El Paso Community College, 1988

LEARNING EXPERIENCES

Performance Enabler No. 2

Demonstrate knowledge of what equipment and what systems are available for use in molding plants.

LEARNING ACTIVITIES

SPECIAL INSTRUCTIONS

Please Do Not Write Or Mark On This Guide

Read: Injection Molding Handbook,
pp, 391-402.

View: Videotape on quick mold charge
device and auxiliary equipment.

This is a continua-
tion of the overview
of auxiliary equip-
ment.

STUDENT LEARNING GUIDE

Advanced Industrial Technology Training Center
c/o El Paso Community College
P.O. Box 20500
El Paso, Texas 79998

COURSE NUMBER AND TITLE: Auxiliary Equipment and Material Handling

DUTY/UNIT: Material Handling

COMPETENCY NUMBER: 2

COMPETENCY: IDENTIFY PROPER USE OF AUXILIARY EQUIPMENT

INTRODUCTION:

In this unit you will learn in detail the various types of auxiliary equipment and their purpose and functions, as well as chilling and cooling, water management, and material handling. This learning guide will help you to acquire this knowledge.

PERFORMANCE OBJECTIVE:

Given appropriate instruction and lab experience, identify the proper use and purpose of auxiliary equipment used in molding plants.

PERFORMANCE ENABLERS:

1. Identify the basic principle of pneumatic conveying.
2. Explain how auxiliary equipment works in the molding process.

Please Do Not Write Or Mark On This Guide

(c) El Paso Community College, 1988

LEARNING EXPERIENCES

Performance Enabler No. 1

Identify the basic principle of pneumatic conveying.

LEARNING ACTIVITIES

SPECIAL INSTRUCTIONS

Please Do Not Write Or Mark On This Guide

Read: Injection Molding Handbook,
pp. 403-411.

This segment deals
with the law of con-
servation of energy
and matter.

(c) El Paso Community College, 1988

LEARNING EXPERIENCES

Performance Enabler No. 2

Explain how auxiliary equipment works in the molding process.

LEARNING ACTIVITIES

SPECIAL INSTRUCTIONS

Please Do Not Write Or Mark On This Guide

Read: Injection Molding Handbook,
pp. 411-455.

Study: Charts of material conveying
equipment and systems made available
to you by your instructor.

This segment gives
you a detailed in-
sight into the vari-
ous kinds of equip-
ment involved in
this course.

STUDENT LEARNING GUIDE

Advanced Industrial Technology Training Center
c/o El Paso Community College
P.O. Box 20500
El Paso, Texas 79998

COURSE NUMBER AND TITLE: Auxiliary Equipment and Material
Handling

DUTY/UNIT: Water Chilling and Recovery Equipment

COMPETENCY NUMBER: 3

COMPETENCY: SELECT AND USE CHILLING AND COOLING SYSTEMS

INTRODUCTION:

In this unit you will study refrigeration and cooling equipment, its different types, and water recovery techniques. This learning guide will help you to learn the skills needed to operate, maintain, and select the proper equipment.

PERFORMANCE OBJECTIVE:

Given appropriate instruction, select and properly use chilling and cooling systems.

PERFORMANCE ENABLERS:

1. Identify chilling and cooling equipment and its purpose.
2. Explain the granulation process.

Please Do Not Write Or Mark On This Guide

(c) El Paso Community College, 1988

LEARNING EXPERIENCES

Performance Enabler No. 1

Identify chilling and cooling equipment and its purpose.

LEARNING ACTIVITIES

SPECIAL INSTRUCTIONS

Please Do Not Write Or Mark On This Guide

Read: Injection Molding Handbook,
pp. 456-468.

Study: Instructor handouts on subject.

This segment deals
with water recovery
and water chilling.

LEARNING EXPERIENCES

Performance Enabler No. 2

Explain the granulation process.

LEARNING ACTIVITIES

SPECIAL INSTRUCTIONS

Please Do Not Write Or Mark On This Guide

Read: Injection Molding Handbook,
pp. 468-478.

Study: Instructor's handouts.

Ask for your instructor's help for
the demonstration of equipment in
plastic lab.

In this learning ex-
perience you will be
studying the compo-
nents of a grinder
and the need for
recovery and recyc-
ling of plastic ma-
terials.

SELF-CHECK

DIRECTIONS

Complete the following questions. If you have any doubts, discuss them with your instructor.

Please Do Not Write Or Mark On This Guide

1. Identify the equipment involved in reprocessing thermoplastic materials.
2. Identify the steps involved in the recovery or reprocessing of thermoplastic materials. (See p. 388.)
3. What are the different kinds of air movers, and how do they operate? (See p. 411.)
4. What are blenders for?
5. What are hopper dryers for?
6. What is the purpose of chilling water? (See p. 456.)

PERFORMANCE TEST

STUDENT'S NAME

DATE

COMPETENCY NUMBER AND STATEMENT

TEST ATTEMPT

3 - Select and use chilling and cooling systems.

1ST 2ND 3RD

DIRECTIONS

(See below)

OVERALL EVALUATION:

PERFORMANCE LEVELS

- 4 Can perform this skill without supervision and with initiative and adaptability to problem situations.
- 3 Can perform this skill satisfactorily without assistance or supervision.
- 2 Can perform this skill satisfactorily but requires some assistance and/or supervision.
- 1 Can perform parts of this skill satisfactorily but requires considerable assistance and/or supervision.
- 0 Cannot perform this skill.

PERFORMANCE STANDARDS

For acceptable achievement, all items should receive a "yes" or "not applicable" response.

Directions: Your instructor will assign you a specific piece of equipment, for which you will identify its purpose, how it operates, and what its function is. In Phase 2, you will answer, in the presence of your instructor, the questions listed on the performance checklist. Your instructor will evaluate your performance on the checklist, as well as your performance in plastic lab. The combination of the two parts will result in a letter grade.

(Continued...)

YES	NO	NOT APPL.

PERFORMANCE TEST (CONT.)

PERFORMANCE STANDARDS

FOR ACCEPTABLE ACHIEVEMENT, ALL ITEMS SHOULD RECEIVE A "YES" OR "NOT APPLICABLE" RESPONSE

YES NO NOT APPL.

- | | | | |
|---|--|--|--|
| 1. List the equipment involved in a recovery process of plastic material in its respective steps. | | | |
| 2. What is the purpose of robots as parts handling equipment. | | | |
| 3. What are the six basic components of vacuum conveyors? | | | |
| 4. What is the purpose of the blowback cycle in a vacuum hopper? | | | |
| 5. What is the purpose of filters? | | | |
| 6. Name at least five major components of a blender. | | | |
| 7. What is the purpose of a hopper dryer? | | | |
| 8. What is the purpose of a dehumidifying dryer? | | | |
| 9. What does "negative pressure system" mean in connection with material handling systems? | | | |
| 10. When and why does one need to treat water? | | | |

(Continued...)

PERFORMANCE TEST (CONT.)

PERFORMANCE STANDARDS

FOR ACCEPTABLE ACHIEVEMENT, ALL ITEMS SHOULD RECEIVE A "YES" OR "NOT APPLICABLE" RESPONSE

YES NO NOT APPL.

- | | YES | NO | NOT APPL. |
|--|-----|----|-----------|
| 11. What does water recovery mean? | | | |
| 12. What is the purpose of a cooling tower? | | | |
| 13. The powder pump is a low-velocity pneumatic conveying system (mark your answer). | | | |

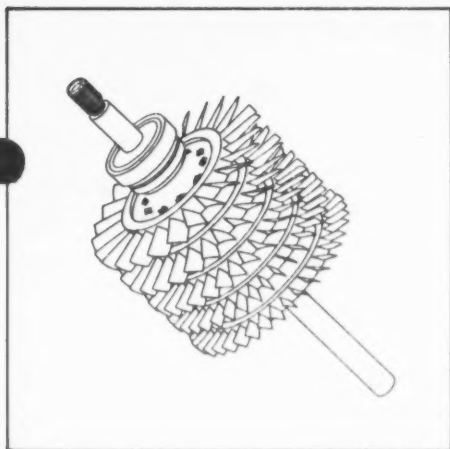
☐

YES

☐

NO

Please Do Not Write Or Mark On This Guide



Student Learning Guide

A Project Funded by
The Texas Higher Education
Coordinating Board
Through the

● Carl D. Perkins Act

Project No. 8788053

INDUSTRIAL MAINTENANCE



**EL PASO
COMMUNITY
COLLEGE**

P.O. Box 20500, El Paso, Texas 79998

ADVANCED INDUSTRIAL TECHNOLOGY TRAINING CENTER

©1988, El Paso Community College

OFFICIAL COURSE OUTLINE

Curriculum Title: Industrial Mechanical Maintenance

Course Title: Pneumatic Controls

Subject Area Code:

Course Hours:

I. Catalog Description

This course provides basic knowledge of pneumatic controls and explains their relationship to each other. It identifies basic functions in the control and transmission of energy, valves, cylinders, motors, and air preparation.

II. Course Objectives

Upon satisfactory completion of this course, the student will be able to:

- A. List the fundamentals of pneumatics.
- B. List graphical communication and parts identification.
- C. Describe air compression and flow control.
- D. Describe, repair, and install valves, cylinders, motors, and regulators.

III. Unit Titles

- A. Unit I - Control of Pneumatic Energy. This unit covers the transmission and control of compressed gases and the hardware used to accomplish this.
- B. Unit II - Compressor Systems. This unit covers compressor types, air distribution systems, valves, cylinders, and motors.
- C. Unit III - Pneumatic Controls. This unit covers directional control valves, silencers, and quick exhausts.

- D. Unit IV - Regulation of Pneumatic Systems. This unit covers the many styles and types of regulators and air preparation for pneumatic systems.

IV. Texts and Materials

A. Required Textbook:

Industrial Pneumatic Technology, Bulletin 0275-B1, Parker Fluidpower, 1980. (Available in college bookstore.)

Introductory Pneumatics Activity Manual, Bender, Myron, Technical Systems, Inc., 1975. (Available in college bookstore.)

B. Materials:

1. Pen or pencil (student's choice).
2. Notebook (student's choice).
3. Safety glasses (must meet OSHA standards).

V. Instructor's Resources

- A. Industrial Pneumatic Technology, Bulletin 0275-B1, Parker Fluidpower, 1980.

- B. Pneumatic Controls for Industrial Application, American Society of Tool and Manufacturing Engineers, 1965.

C. Filmstrips:

Lab-Volt Technical Systems, Inc.: Pneumatic Systems.

VI. Evaluation Measures

Performance Exercises	-	40% of final grade
Lab Experiments	-	<u>60% of final grade</u>
TOTAL		100%

Grading Scale

90 - 100	A
80 - 89	B
70 - 79	C
60 - 69	D
0 - 59	F

The grades of "I" (Incomplete) and "W" (Withdraw) will be given in accordance with college policy.

STUDENT LEARNING GUIDE

**Advanced Industrial Technology Training Center
c/o El Paso Community College
P.O. Box 20500
El Paso, Texas 79998**

COURSE NUMBER AND TITLE: Pneumatic Controls

DUTY/UNIT: Control of Pneumatic Energy

COMPETENCY NUMBER: 1

COMPETENCY: DEMONSTRATE ASPECTS OF COMPRESSED AIR USE

INTRODUCTION:

Pneumatics involves the flow and pressure of gases in fluid power systems. Compressed air is by far the most widely used gas. Since compressed air is widely used to transmit power in industry throughout the world, it would be logical to say that the growth rate of the use of compressed air will parallel that of industry.

PERFORMANCE OBJECTIVE:

Given access to a pneumatic trainer device, demonstrate advantages, disadvantages, and the basic laws of compressed air.

PERFORMANCE ENABLERS:

1. Demonstrate knowledge of the fundamentals of pneumatics.
2. Demonstrate the relationship between pressure and volume.
3. Demonstrate knowledge of the different types of compressors.
4. Demonstrate knowledge of how air flows.

Please Do Not Write Or Mark On This Guide

LEARNING EXPERIENCES

Performance Enabler No. 1

Demonstrate knowledge of the fundamentals of pneumatics.

LEARNING ACTIVITIES

SPECIAL INSTRUCTIONS

Please Do Not Write Or Mark On This Guide

Read: Introductory Pneumatics Activity Manual, pp. 1-1, 1-4.

Read: I.P.A.M., pp. 2-1, 2-7.

Answer the study questions on p. 1-4.

Be able to sketch the symbols used in a pneumatic system.

(c) El Paso Community College, 1988

LEARNING EXPERIENCES

Performance Enabler No. 2

Demonstrate the relationship between pressure and volume.

LEARNING ACTIVITIES

SPECIAL INSTRUCTIONS

Please Do Not Write Or Mark On This Guide

Read: Fundamentals of Pneumatic Control,
Section 1.

Read: Pneumatic Controls for Industrial
Application, pp. 1-11.

Read: Pneumatic Activity Manual, pp.
3-1 through 3-4.

View the videotape on compressed air.

Set up experiment #3 as per instruc-
tions on pp. 3-7 through 3-8. Complete
the record chart and questions on p.
3-8.

If you have any questions about the
reading assignments or experiment, ask
your instructor for help.

Answer the study
questions on p.
3-6.

LEARNING EXPERIENCES

Performance Enabler No. 3

Demonstrate knowledge of the different types of compressors.

LEARNING ACTIVITIES

SPECIAL INSTRUCTIONS

Please Do Not Write Or Mark On This Guide

Read: Fundamentals of Pneumatic Control,
Section 2.

Read: Pneumatic Controls for Industrial
Applications, pp. 11-21.

Read: Pneumatic Activity Manual, pp.
4-1 through 4-8.

If you have any
questions during
your reading or lab,
ask your instructor
for help.

Answer the study
questions on pp.
4-8 through 4-9.

Complete Lab Activi-
ty on p. 4-9.

LEARNING EXPERIENCES

Performance Enabler No. 4

Demonstrate knowledge of how air flows.

LEARNING ACTIVITIES

SPECIAL INSTRUCTIONS

Please Do Not Write Or Mark On This Guide

Read: Fundamentals of Pneumatic Control,
Section 3.

Read: Pneumatic Controls for Industrial
Applications, Chapter 5, pp. 97-110.

Complete Experiment #5 of Activity
Manual and answer the study questions.

Ask your instructor
for help if needed.

(c) El Paso Community College, 1988

PERFORMANCE TEST

STUDENT'S NAME

DATE

COMPETENCY NUMBER AND STATEMENT

TEST ATTEMPT

1 - Demonstrate aspects of compressed air use.

1ST 2ND 3RD

DIRECTIONS
(See below)

OVERALL EVALUATION:

PERFORMANCE LEVELS

- 4 Can perform this skill without supervision and with initiative and adaptability to problem situations.
- 3 Can perform this skill satisfactorily without assistance or supervision.
- 2 Can perform this skill satisfactorily but requires some assistance and/or supervision.
- 1 Can perform parts of this skill satisfactorily but requires considerable assistance and/or supervision.
- 0 Cannot perform this skill.

PERFORMANCE STANDARDS

For acceptable achievement, all items should receive a "yes" or "not applicable" response.

	YES	NO	NOT APPL.
1. <u>Does the student know:</u>			
a. Physical properties of compressed air.			
b. Kinds of air pressure.			
c. Relationship between gauge and absolute pressure.			
d. Boyle's Law as it pertains to pneumatics.			
e. Safety procedures.			
(Continued...)			

PERFORMANCE TEST (CONT.)

PERFORMANCE STANDARDS

FOR ACCEPTABLE ACHIEVEMENT, ALL ITEMS SHOULD RECEIVE A "YES" OR "NOT APPLICABLE" RESPONSE

YES NO NOT APPL.

- | | YES | NO | NOT APPL. |
|---|-----|----|-----------|
| 2. <u>Did the student follow:</u> | | | |
| a. Experimental procedure. | | | |
| b. Directions of the experiment. | | | |
| 3. <u>Does the student know:</u> | | | |
| a. Definition of pneumatics. | | | |
| b. Applications of pneumatics. | | | |
| c. Definition of fluid power. | | | |
| d. Common methods used to transmit power. | | | |
| e. Advantages of pneumatic power. | | | |
| f. Disadvantages of pneumatic power. | | | |
| g. Pneumatic components by their symbols. | | | |
| h. How to draw the symbol for each component. | | | |

Please Do Not Write Or Mark On This Guide

STUDENT LEARNING GUIDE

**Advanced Industrial Technology Training Center
c/o El Paso Community College
P.O. Box 20500
El Paso, Texas 79998**

COURSE NUMBER AND TITLE: Pneumatic Controls

DUTY/UNIT: Compressor Systems

COMPETENCY NUMBER: 2

COMPETENCY: DEMONSTRATE ASPECTS OF COMPRESSOR SYSTEMS

INTRODUCTION:

These assignments will acquaint you with an air line filter, control of pressure, the relationship between pressure and flow, and functional characteristics of linear actuators. This is the beginning of the pneumatic system.

PERFORMANCE OBJECTIVE:

Given access to a pneumatic training device, demonstrate filters, air pressure, flow, and linear actuators.

PERFORMANCE ENABLERS:

1. Demonstrate the operation of an air line filter.
2. Demonstrate the control of pressure and the measurement of pressure.
3. Demonstrate the relationship between pressure and flow.
4. Demonstrate a simple acting spring return linear actuator.

Please Do Not Write Or Mark On This Guide

(c) El Paso Community College, 1988

LEARNING EXPERIENCES

Performance Enabler No. 1

Demonstrate the performance of an air line filter.

LEARNING ACTIVITIES

SPECIAL INSTRUCTIONS

Please Do Not Write Or Mark On This Guide

Read: Fundamentals of Pneumatic Control,
Section 6, pp. 1-4.

Read: Controls for Industrial
Application, Chapter 4, pp. 75-84.

Complete Lab Experiment #6, Activity
Manual; p. 6-3.

Answer the study
questions in the
Activity Manual,
p. 6-2.

Answer the questions
carefully.

Follow the procedure
step by step.

Ask your instructor
for help if needed.

(c) El Paso Community College, 1988

LEARNING EXPERIENCES

Performance Enabler No. 2

Demonstrate the control of pressure and the measurement of pressure.

LEARNING ACTIVITIES

SPECIAL INSTRUCTIONS

Please Do Not Write Or Mark On This Guide

Read: Fundamentals of Pneumatic Control,
Section 5, pp. 8-9.

Read: Pneumatic Controls for Industrial
Applications, Chapter 2, pp. 26-31.

Complete Lab Experiment #7 of the
Activity Manual, pp. 7-1 through 7-5.

Answer all questions
completely, and fol-
low all procedures
step by step.

Ask your instructor
for help if needed.

(c) El Paso Community College, 1988

LEARNING EXPERIENCES

Performance Enabler No. 3

Demonstrate the relationship between pressure and flow.

LEARNING ACTIVITIES

SPECIAL INSTRUCTIONS

Please Do Not Write Or Mark On This Guide

Complete Lab Experiment #8 in the Activity Manual, pp. 8-1 through 8-4.

Answer all questions completely, and follow all procedures step by step.

Ask your instructor for help if needed.

(c) El Paso Community College, 1988

LEARNING EXPERIENCES

Performance Enabler No. 4

Demonstrate a single acting spring return linear actuator.

LEARNING ACTIVITIES

SPECIAL INSTRUCTIONS

Please Do Not Write Or Mark On This Guide

Read: Pneumatic Controls for Industrial Applications, Chapter 3, pp. 57-69.

Complete Lab Experiment #9 in the Activity Manual, pp. 9-1 through 9-4.

Answer all questions completely, and follow all procedures step by step.

Ask your instructor for help if needed.

(c) El Paso Community College, 1988

STUDENT LEARNING GUIDE

**Advanced Industrial Technology Training Center
c/o El Paso Community College
P.O. Box 20500
El Paso, Texas 79998**

COURSE NUMBER AND TITLE: Pneumatic Controls

DUTY/UNIT: Pneumatic Controls

COMPETENCY NUMBER: 3

COMPETENCY: DEMONSTRATE HOW COMPRESSED AIR IS USED

INTRODUCTION:

Being able to receive the maximum force needed is very important in modern industry. The use of actuators for pressure, speed control, and control devices has become necessary for undertaking the operations of modern industry.

PERFORMANCE OBJECTIVE:

Given access to a pneumatic trainer device, demonstrate ways that compressed air is controlled and used.

PERFORMANCE ENABLERS:

1. Demonstrate the operating principles of a double-acting cylinder.
2. Demonstrate the force, pressure, and area factors as they relate to pneumatics.
3. Demonstrate double-acting cylinder speed control.
4. Demonstrate the uses of air control devices.

Please Do Not Write Or Mark On This Guide

LEARNING EXPERIENCES

Performance Enabler No. 1

Demonstrate the operating principles of a double-acting cylinder.

LEARNING ACTIVITIES

SPECIAL INSTRUCTIONS

Please Do Not Write Or Mark On This Guide

Read: Fundamentals of Pneumatic Control,
Section 4, pp. 2-5; Section 7, pp. 1-4.

Complete Lab Experiment #10 in the
Activity Manual, pp. 10-1 through 10-4.

Answer all questions
completely, and fol-
low all procedures
step by step.

Ask your instructor
for help if needed.

(c) El Paso Community College, 1988

LEARNING EXPERIENCES

Performance Enabler No. 2

Demonstrate the force, pressure, and area factors as they relate to pneumatics.

LEARNING ACTIVITIES

SPECIAL INSTRUCTIONS

Please Do Not Write Or Mark On This Guide

Complete Lab Experiment #11 in the Activity Manual, pp. 11-1 through 11-3.

Answer all questions and follow the procedures step by step.

Ask your instructor if help is needed.

(c) El Paso Community College, 1988

LEARNING EXPERIENCES

Performance Enabler No. 3

Demonstrate double-acting cylinder speed control.

LEARNING ACTIVITIES

SPECIAL INSTRUCTIONS

Please Do Not Write Or Mark On This Guide

Read: Pneumatic Controls for Industrial Applications, pp. 51-56.

Complete Lab Experiment #12 in the Activity Manual, pp. 12-1 through 12-4.

Answer all questions and follow the procedures step by step.

Ask your instructor if help is needed.

(c) El Paso Community College, 1988

LEARNING EXPERIENCES

Performance Enabler No. 4

Demonstrate the uses of air control devices.

LEARNING ACTIVITIES

SPECIAL INSTRUCTIONS

Please Do Not Write Or Mark On This Guide

Read: Pneumatic Controls for Industrial Applications, Chapter 2, pp. 26-56.

Complete Lab Experiment #13 in the Activity Manual, pp. 13-1 through 13-3.

Answer all questions and follow the procedures step by step.

Ask your instructor if help is needed.

(c) El Paso Community College, 1988

STUDENT LEARNING GUIDE

**Advanced Industrial Technology Training Center
c/o El Paso Community College
P.O. Box 20500
El Paso, Texas 79998**

COURSE NUMBER AND TITLE: Pneumatic Controls

DUTY/UNIT: Regulation of the Pneumatic System

COMPETENCY NUMBER: 4

COMPETENCY: DEMONSTRATE PRINCIPLES OF PNEUMATIC CYCLES

INTRODUCTION:

Many times the system must do more than one operation. Air motors are used by industry because of air supply and low weight-to-power ratio. The uses of air bearings and velocity-pressure relationships become more important.

PERFORMANCE OBJECTIVE:

Given access to a pneumatic trainer device, demonstrate how cylinders, rotary actuators, and velocity-pressure relationships become very important.

PERFORMANCE ENABLERS:

1. Construct and demonstrate a pressure type of sequence circuit.
2. Demonstrate relationship of flow, pressure, and rpm without air motor load.
3. Demonstrate the air bearing principle.
4. Construct the circuit and demonstrate the venturi device.

Please Do Not Write Or Mark On This Guide

LEARNING EXPERIENCES

Performance Enabler No. 1

Construct and demonstrate a pressure type of sequence circuit.

LEARNING ACTIVITIES

SPECIAL INSTRUCTIONS

Please Do Not Write Or Mark On This Guide

Read: Fundamentals of Pneumatic Control,
Sections 5 and 8.

Read: Pneumatic Controls for Industrial
Applications, Chapter 6, pp. 111-162.

Complete Lab Experiment #14 of the
Activity Manual, pp. 14-1 through 14-4.

Answer all questions
and follow pro-
cedures step by
step.

Ask your instructor
for help if needed.

(c) El Paso Community College, 1988

LEARNING EXPERIENCES

Performance Enabler No. 2

Demonstrate the relationship of flow, pressure, and rpm without motor load.

LEARNING ACTIVITIES

SPECIAL INSTRUCTIONS

Please Do Not Write Or Mark On This Guide

Read: Pneumatic Controls for Industrial Applications, pp. 69-74.

Complete Lab Experiment #15 in the Activity Manual, pp. 15-1 through 15-5.

Answer all questions and follow the procedures step by step.

Ask your instructor if help is needed.

(c) El Paso Community College, 1988

LEARNING EXPERIENCES

Performance Enabler No. 3

Demonstrate the air bearing principle.

LEARNING ACTIVITIES

SPECIAL INSTRUCTIONS

Please Do Not Write Or Mark On This Guide

Complete Lab Experiment #16 in the Activity Manual, pp. 16-1 through 16-3.

Answer all questions and follow the procedures step by step.

Ask your instructor if help is needed.

(c) El Paso Community College, 1988

LEARNING EXPERIENCES

Performance Enabler No. 4

Construct the circuit and demonstrate the venturi device.

LEARNING ACTIVITIES

SPECIAL INSTRUCTIONS

Please Do Not Write Or Mark On This Guide

Read: Fundamentals of Pneumatic Control,
Section 3, pp. 1-9.

Complete Lab Experiment #17 in the
Activity Manual, pp. 17-1 through 17-4.

Answer all questions
and follow the pro-
cedures step by
step.

Ask your instructor
if help is needed.

OFFICIAL COURSE OUTLINE

Curriculum Title: Industrial Mechanical Maintenance
Course Title: Hydraulics II
Subject Area Code:
Course Hours:

I. Catalog Description

This unit is an introduction to the field of hydraulics as used in industry and in mobile equipment operation. In this course there are 18 reading and lab activities. Each activity will help us develop your skills in becoming a hydraulic repairperson.

II. Course Objectives

Upon satisfactory completion of this course, the student will be able to:

- A. Describe and perform the fundamentals of hydraulic operations.
- B. Describe and perform the uses of hydraulic fluids.
- C. Describe and perform the control of fluid movement.
- D. Describe and perform activities in the correct use of actuators.

III. Unit Titles

- A. Unit I - Fundamentals of Hydraulics. This unit will cover circuits, basic physical laws, pressure and force, flow, work, power, and horsepower.
- B. Unit II - Hydraulic Fluids. This unit covers hydraulic fluids, power symbols, pumps, and the storage and conditioning of fluids.
- C. Unit III - Hydraulic Controls. This unit introduces control valves, pressure control, directional control, and flow control of the system.

- D. Unit IV - Actuators and Leakage Control. This unit covers linear and rotary actuators, basic flow circuits, and directional valve leakage and control.

IV. Texts and Materials

A. Required Textbooks:

Mobile Hydraulics Manual, (M-2990-A), Vickers, 1985. (Available in college bookstore.)

Hydraulics II and III Activity Manual (TM-16654), Lab-Volt Systems, 1983. (Available in college bookstore.)

B. Materials:

1. Pen or pencil
2. Safety glasses (must meet OSHA standards)

V. Instructor's Resources

A. Mobile Hydraulics Manual (M-2990-A), Vickers, 1985.

B. Industrial Hydraulic Technology (Bulletin 0221-B1), Parker-Hannefin Corp., 1985.

C. Filmstrips:

Tel-A-Train, Inc., Hydraulics

VI. Evaluation Measures

Study Questions	-	40% of final grade
Lab Activities	-	<u>60% of final grade</u>
TOTAL		100%

Grading Scale

90 - 100	A
80 - 89	B
70 - 79	C
60 - 69	D
0 - 59	F

The grades of "I" (Incomplete) and "W" (Withdraw) will given in accordance with college policy.

STUDENT LEARNING GUIDE

**Advanced Industrial Technology Training Center
c/o El Paso Community College
P.O. Box 20500
El Paso, Texas 79998**

COURSE NUMBER AND TITLE: Hydraulics II

DUTY/UNIT: Fundamentals of Hydraulics

COMPETENCY NUMBER: 1

COMPETENCY: DEMONSTRATE AREAS OF FLUID MOVEMENT AND CONTROL

INTRODUCTION:

This unit introduces the basic areas needed for you to prepare yourself to perform hydraulic maintenance. Each reading assignment will be reinforced by a lab activity. Each activity will have objectives, study questions, and activity specifications.

PERFORMANCE OBJECTIVE:

Given access to a hydraulic trainer device, demonstrate the basic areas of fluid movement and control. The basic laws of hydraulics will be stressed in this unit.

PERFORMANCE ENABLERS:

1. Know and demonstrate the fundamentals of hydraulic circuits.
2. Know and demonstrate the basic physical laws.
3. Know and demonstrate the principles of pressure and flow.
4. Know and demonstrate work, power, and horsepower.
5. Know and demonstrate flow rate and velocity.

Please Do Not Write Or Mark On This Guide

(c) El Paso Community College, 1988

LEARNING EXPERIENCES

Performance Enabler No. 1

Know and demonstrate the fundamentals of hydraulic circuits.

LEARNING ACTIVITIES

SPECIAL INSTRUCTIONS

Please Do Not Write Or Mark On This Guide

Read: Mobile Hydraulics Manual, Foreword, pp. 1, 17, and 21.

Answer study questions on pp. 1-1 and 1-2 of Activity Manual.

Set up Activity #1.

Turn in to instructor.

Follow the procedure step by step. Complete the worksheet and answer the worksheet questions.

Ask your instructor for help if needed.

(c) El Paso Community College, 1988

LEARNING EXPERIENCES

Performance Enabler No. 2

Know and demonstrate the basic physical laws.

LEARNING ACTIVITIES

SPECIAL INSTRUCTIONS

Please Do Not Write Or Mark On This Guide

Read: Mobile Hydraulics Manual, pp. 1-5 and 11-14.

Answer the study questions in the Activity Manual, p. 2-1.

Set up Activity #2.

Turn in to instructor.

Follow the procedures in your manual very carefully. Complete the worksheet. Answer the activity questions.

Ask your instructor for help if needed.

(c) El Paso Community College, 1988

LEARNING EXPERIENCES

Performance Enabler No. 3

Know and demonstrate the principles of pressure and flow.

LEARNING ACTIVITIES

SPECIAL INSTRUCTIONS

Please Do Not Write Or Mark On This Guide

Read: Mobile Hydraulics Manual, pp. 2-10.

Answer the study questions in the Activity Manual, pp. 3-1 and 3-2.

Set up Activity #3.

Turn in to the instructor.

Follow the procedures in your manual very carefully. Complete the worksheet and answer the activity questions.

Ask your instructor if help is needed.

(c) El Paso Community College, 1988

LEARNING EXPERIENCES

Performance Enabler No. 4

Know and demonstrate work, power, and horsepower.

LEARNING ACTIVITIES

SPECIAL INSTRUCTIONS

Please Do Not Write Or Mark On This Guide

Read: Mobile Hydraulics Manual, pp. 11-13.

Answer the study questions in the Activity Manual, pp. 4-1 and 4-2.

Set up Activity #4.

Turn in to instructor.

Follow the procedure very carefully. Complete the worksheet and answer the questions in the activity.

Ask your instructor for help if needed.

(c) El Paso Community College, 1988

LEARNING EXPERIENCES

Performance Enabler No. 5

Know and demonstrate flow rate and velocity.

LEARNING ACTIVITIES

SPECIAL INSTRUCTIONS

Please Do Not Write Or Mark On This Guide

Read: Mobile Hydraulics Manual, pp. 15 and 17.

Answer the study questions in the Activity Manual, p. 5-1.

Set up Activity #5.

Turn in to instructor.

Follow the procedure very carefully. Complete the worksheet and answer the activity questions.

Ask your instructor for help if needed.

(c) El Paso Community College, 1988

STUDENT LEARNING GUIDE

**Advanced Industrial Technology Training Center
c/o El Paso Community College
P.O. Box 20500
El Paso, Texas 79998**

COURSE NUMBER AND TITLE: Hydraulics II

DUTY/UNIT: Hydraulic Fluids

COMPETENCY NUMBER: 2

COMPETENCY: DEMONSTRATE USES AND CARE OF FLUIDS

INTRODUCTION:

This unit introduces the fluids of the hydraulic circuits. There are two liquids which have been used in hydraulic systems: water and oil.

PERFORMANCE OBJECTIVE:

Given access to a hydraulic trainer device, demonstrate the uses and correct care of hydraulic fluids.

PERFORMANCE ENABLERS:

1. Demonstrate the effect of a particular fluid property (viscosity) on system behavior.
2. Explain the various fluid power diagrams, particularly the graphic symbol system.
3. Demonstrate how pressure is produced.
4. Demonstrate that hydraulic fluid is the blood of a system.
5. Demonstrate the conductors through which hydraulic fluid travels between components.

Please Do Not Write Or Mark On This Guide

(c) El Paso Community College, 1988

LEARNING EXPERIENCES

Performance Enabler No. 1

Demonstrate the effect of a particular fluid property (viscosity) on system behavior.

LEARNING ACTIVITIES

SPECIAL INSTRUCTIONS

Please Do Not Write Or Mark On This Guide

Read: Mobile Hydraulics Manual,
Appendix A.

Answer the study questions in the
Activity Manual, pp. 6-1 and 6-2.

Set up Activity #6.

Turn in to instructor.

Follow the procedures very carefully. Complete the worksheet and answer the activity questions.

Ask your instructor for help if needed.

(c) El Paso Community College, 1988

LEARNING EXPERIENCES

Performance Enabler No. 2

Introduce the various fluid power diagrams, particularly the graphic symbol system.

LEARNING ACTIVITIES

SPECIAL INSTRUCTIONS

Please Do Not Write Or Mark On This Guide

Read: Mobile Hydraulics Manual, pp. 128-130.

Answer the study questions in the Activity Manual, pp. 7-2 and 7-3.

Set up Activity #7.

Turn in to your instructor.

Follow the procedure very carefully. Answer the activity questions.

Ask your instructor for help if needed.

(c) El Paso Community College, 1988

LEARNING EXPERIENCES

Performance Enabler No. 3

Demonstrate how pressure is produced.

LEARNING ACTIVITIES

SPECIAL INSTRUCTIONS

Please Do Not Write Or Mark On This Guide

Read: Mobile Hydraulics Manual, pp. 37-53.

Answer the study questions in the activity manual, pp. 8-1 and 8-2.

Set up Activity #8.

Turn in to your instructor.

Follow the procedure very carefully. Complete the worksheet and answer the activity questions.

Ask your instructor for help if needed.

(c) El Paso Community College, 1988

LEARNING EXPERIENCES

Performance Enabler No. 4

Demonstrate that hydraulic fluid is the blood of a system.

LEARNING ACTIVITIES

SPECIAL INSTRUCTIONS

Please Do Not Write Or Mark On This Guide

Read: Mobile Hydraulics Manual, pp. 22-33.

Answer the study questions in the Activity Manual, pp. 9-1 and 9-2.

Set up Activity #9.

Turn in to your instructor.

Follow the procedure very carefully. Complete the worksheet and answer the activity questions.

Ask your instructor if help is needed.

(c) El Paso Community College, 1988

LEARNING EXPERIENCES

Performance Enabler No. 5

Demonstrate the conductors through which hydraulic fluid travels between components.

LEARNING ACTIVITIES

SPECIAL INSTRUCTIONS

Please Do Not Write Or Mark On This Guide

Read: Mobile Hydraulics Manual, pp. 161-165.

Answer the study questions in the Activity Manual, p. 10-2.

Set up Activity #10.

Turn in to your instructor.

Follow the procedure very carefully. Complete the worksheet and answer the activity questions.

Ask your instructor for help if needed.

(c) El Paso Community College, 1988

STUDENT LEARNING GUIDE

**Advanced Industrial Technology Training Center
c/o El Paso Community College
P.O. Box 20500
El Paso, Texas 79998**

COURSE NUMBER AND TITLE: Hydraulics II

DUTY/UNIT: Control of Fluid Movement

COMPETENCY NUMBER: 3

COMPETENCY: DEMONSTRATE HOW VALVES CONTROL SYSTEM FLUIDS

INTRODUCTION:

This unit introduces the large variety of control valves that greatly increase the versatility of the system.

PERFORMANCE OBJECTIVE:

Given access to a hydraulic trainer device, demonstrate how valves are used to control the fluid in a system.

PERFORMANCE ENABLERS:

1. Explain and demonstrate the application of control valves.
2. Demonstrate how a pressure control valve operates.
3. Demonstrate what happens inside the valve when the handle is moved.
4. Demonstrate the compensated and noncompensated flow controls.

Please Do Not Write Or Mark On This Guide

(c) El Paso Community College, 1988

LEARNING EXPERIENCES

Performance Enabler No. 1

Explain and demonstrate the application of control valves.

LEARNING ACTIVITIES

SPECIAL INSTRUCTIONS

Please Do Not Write Or Mark On This Guide

Read: Mobile Hydraulics Manual, pp. 81-99.

Answer study questions in the Activity Manual, p. 11-2.

Set up Activity #11.

Turn in to your instructor.

Follow the procedure very carefully. Complete the worksheet and answer the activity questions.

Ask your instructor for help if needed.

(c) El Paso Community College, 1988

LEARNING EXPERIENCES

Performance Enabler No. 2

Demonstrate how a pressure control valve operates.

LEARNING ACTIVITIES

SPECIAL INSTRUCTIONS

Please Do Not Write Or Mark On This Guide

Read: Mobile Hydraulics Manual, pp. 8-93.

Answer the study questions in the Activity Manual, pp. 12-1 and 12-2.

Set up Activity #12.

Turn in to your instructor.

Follow the procedure very carefully. Complete the worksheet and answer the activity questions.

Ask your instructor if help is needed.

(c) El Paso Community College, 1988

LEARNING EXPERIENCES

Performance Enabler No. 3

Demonstrate what happens inside the valve when the handle is moved.

LEARNING ACTIVITIES

SPECIAL INSTRUCTIONS

Please Do Not Write Or Mark On This Guide

Read: Mobile Hydraulics Manual, pp. 82, 98-100, and 107.

Answer the study questions in the Activity Manual, pp. 13-1 and 13-2.

Set up Activity #13.

Turn in to your instructor.

Follow the procedure very carefully. Answer the activity questions.

Ask your instructor for help if needed.

(c) El Paso Community College, 1988

LEARNING EXPERIENCES

Performance Enabler No. 4

Demonstrate compensated and noncompensated flow controls.

LEARNING ACTIVITIES

SPECIAL INSTRUCTIONS

Please Do Not Write Or Mark On This Guide

Read: Mobile Hydraulics Manual, pp. 95-97.

Answer the study questions in the Activity Manual, p. 14-1.

Set up Activity #14.

Turn in to your instructor.

Follow the procedure very carefully. Complete the worksheet and answer the activity questions.

Ask your instructor for help if needed.

(c) El Paso Community College, 1988

STUDENT LEARNING GUIDE

Advanced Industrial Technology Training Center
c/o El Paso Community College
P.O. Box 20500
El Paso, Texas 79998

COURSE NUMBER AND TITLE: Hydraulics II

DUTY/UNIT: Hydraulic Energy and Mechanical Work

COMPETENCY NUMBER: 4

COMPETENCY: DEMONSTRATE ACTUATORS IN MOTION AND AT WORK

INTRODUCTION:

This unit introduces the actuator and the many ways it can be used in modern industry. Design features, performance factors, and leakage will be high points of study.

PERFORMANCE OBJECTIVE:

Given access to a hydraulic trainer device, demonstrate the use of actuators in motion and at work.

PERFORMANCE ENABLERS:

1. Demonstrate the circuit principle of several cylinders working together.
2. Demonstrate continuous motion with a hydraulic motor.
3. Demonstrate actuator speed and how flow control circuits can affect the way a system responds to the load.
4. Demonstrate control of valve leakage and variable control with directional control valves.

Please Do Not Write Or Mark On This Guide

(c) El Paso Community College, 1988

LEARNING EXPERIENCES

Performance Enabler No. 1

Demonstrate the circuit principles of several cylinders working together.

LEARNING ACTIVITIES

SPECIAL INSTRUCTIONS

Please Do Not Write Or Mark On This Guide

Read: Mobile Hydraulics Manual, pp. 61-68.

Answer the study questions in the Activity Manual, pp. 15-1 and 15-2.

Set up Activity #15.

Turn in to your instructor.

Follow the procedure very carefully. Complete the worksheet and answer the activity questions.

Ask your instructor for help if needed.

(c) El Paso Community College, 1988

LEARNING EXPERIENCES

Performance Enabler No. 2

Demonstrate continuous motion with a hydraulic motor.

LEARNING ACTIVITIES

SPECIAL INSTRUCTIONS

Please Do Not Write Or Mark On This Guide

Read: Mobile Hydraulics Manual, pp. 68-79.

Answer the study questions in the Activity Manual, pp. 16-1 and 16-2.

Set up Activity #16.

Turn in to your instructor.

Follow the procedure very carefully. Complete the worksheet and answer the activity questions.

Ask your instructor for help if needed.

(c) El Paso Community College, 1988

LEARNING EXPERIENCES

Performance Enabler No. 3

Demonstrate actuator speed and how flow control circuits can affect the way a system responds to the load.

LEARNING ACTIVITIES

SPECIAL INSTRUCTIONS

Please Do Not Write Or Mark On This Guide

Read: Mobile Hydraulics Manual, pp. 95-96.

Answer the study questions in the Activity Manual, p. 17-1.

Set up Activity #17.

Turn in to your instructor.

Follow the procedure very carefully. Complete the worksheet and answer the activity questions.

Ask your instructor for help if needed.

LEARNING EXPERIENCES

Performance Enabler No. 4

Demonstrate control of valve leakage and variable control with directional control valves.

LEARNING ACTIVITIES

SPECIAL INSTRUCTIONS

Please Do Not Write Or Mark On This Guide

Read: Mobile Hydraulics Manual, pp. 98-102.

Answer the study questions in the Activity Manual, p. 18-1.

Set up Activity #18.

Turn in to your instructor.

Follow the procedure very carefully. Complete the worksheet and answer the study questions.

Ask your instructor if help is needed.

(c) El Paso Community College, 1988

OFFICIAL COURSE OUTLINE

Curriculum Title: Industrial Mechanical Maintenance

Course Title: Hydraulics III

Subject Area Code:

Course Hours:

I. Catalog Description

This course is an advanced continuation of Hydraulics II, which must be completed before advancement to Hydraulics III. In this course there are 12 reading and activity lab areas. This unit will advance the working skills of a hydraulic repairperson.

II. Course Objectives

Upon satisfactory completion of this course, the student will be able to:

- A. Explain and demonstrate the advanced area of circuits.
- B. Explain and demonstrate the advanced area of valves and circuits.
- C. Explain and demonstrate remote controls and hydraulic circuit troubleshooting.

III. Unit Titles

- A. Unit I - Advanced Hydraulic Circuits. This unit covers sequence, rapid traverse, feed, and counterbalance circuits. Accumulator design and function will also be covered.
- B. Unit II - Advanced Valves and Circuits. This unit covers applications, reducing, unloading, and regeneration of valves and circuits.
- C. Unit III - Remote Control, Filtration, and Troubleshooting. This unit covers remote control, fluid filtration, and troubleshooting hydraulic circuits.

IV. Texts and Materials

A. Required Texts

Mobile Hydraulics Manual (M-2990-A), Vickers, 1985.

Industrial Hydraulic Technology (Bulletin 0221-B1), Parker Hannifin Corp., 1985. (Available in college bookstore.)

Hydraulics II and II Activity Manual (TM-16654), Lab-Volt Systems, 1983. (Available in college bookstore.)

B. Materials

1. Pen or pencil
2. Safety glasses (must meet OSHA standards)

V. Instructor's Resources

(Same as in Heading IV.)

VI. Evaluation Measures

Study Questions	-	40% of final grade
Lab Activities	-	<u>60% of final grade</u>
TOTAL		100%

Grading Scale

90 - 100	A
80 - 89	B
70 - 79	C
60 - 69	D
0 - 59	F

The grade of "I" (Incomplete) and "W" (Withdraw) will be given in accordance with college policy.

STUDENT LEARNING GUIDE

**Advanced Industrial Technology Training Center
c/o El Paso Community College
P.O. Box 20500
El Paso, Texas 79998**

COURSE NUMBER AND TITLE: Hydraulics III

DUTY/UNIT: Advanced Circuits

COMPETENCY NUMBER: 1

COMPETENCY: DEMONSTRATE AND EXPLAIN CIRCUITS & ACCUMULATORS

INTRODUCTION:

This unit introduces the sequence circuit, rapid traverse and feed circuits, counterbalance circuits, and accumulator design and functions. The unit also reinforces the principles learned in previous learning guides.

PERFORMANCE OBJECTIVE:

Given access to a hydraulic trainer device, demonstrate and explain circuits and accumulator functions.

PERFORMANCE ENABLERS:

1. Demonstrate and explain how a sequence valve operates.
2. Demonstrate a common method of valve actuation for industrial fluid power application.
3. Demonstrate and explain the reason that the pressure changes in circuits which use counterbalance valves.
4. Explain and measure the volume of the training bench accumulator.
5. Demonstrate and explain how accumulators are used in operating circuits.

Please Do Not Write Or Mark On This Guide

(c) El Paso Community College, 1988

LEARNING EXPERIENCES

Performance Enabler No. 1

Demonstrate and explain how a sequence valve operates.

LEARNING ACTIVITIES

SPECIAL INSTRUCTIONS

Please Do Not Write Or Mark On This Guide

Read: Mobile Hydraulics Manual, pp. 81-82 and 86-89.

Read: Industrial Hydraulics Technology, p. 9-2.

Answer the study questions in the Activity Manual, p. 19-1.

Set up Activity #19.

Turn in to your instructor.

Follow the procedure very carefully. Complete the worksheet and answer the activity questions.

Ask your instructor for help if needed.

(c) El Paso Community College, 1988

LEARNING EXPERIENCES

Performance Enabler No. 2

Demonstrate a common method of valve actuation for industrial fluid power application.

LEARNING ACTIVITIES

SPECIAL INSTRUCTIONS

Please Do Not Write Or Mark On This Guide

Read: Mobile Hydraulics Manual, pp. 95-96.

Read: Industrial Hydraulics Technology, pp. 5-4, 7-1, and 7-13.

Answer the study questions in the Activity Manual, p. 20-2.

Set up Activity #20.

Turn in to your instructor.

Follow the procedure very carefully. Complete the worksheet and answer the activity questions.

Ask your instructor for help if needed.

LEARNING EXPERIENCES

Performance Enabler No. 3

Demonstrate and explain the reason that the pressure changes in circuits which use counterbalance valves.

LEARNING ACTIVITIES

SPECIAL INSTRUCTIONS

Please Do Not Write Or Mark On This Guide

Read: Mobile Hydraulics Manual, pp. 89-91.

Read: Industrial Hydraulics Technology, pp. 9-2, 9-3, and 9-6.

Answer the study questions in the Activity Manual, p. 21-1.

Set up Activity #21.

Turn in to your instructor.

Follow the procedure very carefully. Complete the worksheet and answer the activity questions.

Ask your instructor if you need help.

(c) El Paso Community College, 1988

LEARNING EXPERIENCES

Performance Enabler No. 4

Explain and measure the volume of the training bench accumulator.

LEARNING ACTIVITIES

SPECIAL INSTRUCTIONS

Please Do Not Write Or Mark On This Guide

Read: Mobile Hydraulics Manual, pp. 33-35.

Read: Industrial Hydraulics Technology, pp. 6-4 through 6-8.

Answer the study questions in the Activity Manual, pp. 22-1 and 22-2.

Set up Activity #22.

Turn in to your instructor.

Follow the procedure very carefully. Complete the worksheet and answer the activity questions.

Ask your instructor if help is needed.

(c) El Paso Community College, 1988

LEARNING EXPERIENCES

Performance Enabler No. 5

Demonstrate and explain how accumulators are used in operating circuits.

LEARNING ACTIVITIES

SPECIAL INSTRUCTIONS

Please Do Not Write Or Mark On This Guide

Read: Mobile Hydraulics Manual, pp. 33-35.

Read: Industrial Hydraulics Technology, pp. 6-1, 6-2, 6-4 through 6-8; 8-6.

Answer the study questions in the Activity Manual, pp. 23-1 and 23-2.

Set up Activity #23.

Turn in to your instructor.

Follow the procedure very carefully. Complete the worksheet and answer the activity questions.

Ask your instructor for help if needed.

STUDENT LEARNING GUIDE

**Advanced Industrial Technology Training Center
c/o El Paso Community College
P.O. Box 20500
El Paso, Texas 79998**

COURSE NUMBER AND TITLE: Hydraulics III

DUTY/UNIT: Advanced Valves

COMPETENCY NUMBER: 2

COMPETENCY: DEMONSTRATE ADVANCED VALVES AND CIRCUITS

INTRODUCTION:

This unit introduces pressure valves, unloading valves, and circuits in their advanced stages of industrial operations.

PERFORMANCE OBJECTIVE:

Given access to a hydraulic trainer device, explain and demonstrate valves and circuits in advanced operation.

PERFORMANCE ENABLERS:

1. Explain and demonstrate pressure reducing valves.
2. Explain and demonstrate the unloading of valves and circuits.
3. Explain and demonstrate the regeneration of circuits.
4. Explain and demonstrate remote control in hydraulic circuits.

Please Do Not Write Or Mark On This Guide

(c) El Paso Community College, 1988

LEARNING EXPERIENCES

Performance Enabler No. 1

Explain and demonstrate pressure reducing valves.

LEARNING ACTIVITIES

SPECIAL INSTRUCTIONS

Please Do Not Write Or Mark On This Guide

Read: Mobile Hydraulics Manual, pp. 83 and 93-94.

Read: Industrial Hydraulics Technology, pp. 9-1 through 9-8, 10-2 through 10-4.

Answer the study questions in the Activity Manual, p. 24-1.

Set up Activity #24.

Turn in to your instructor.

Follow the procedure very carefully. Complete the worksheet and answer the activity questions.

Ask your instructor if help is needed.

LEARNING EXPERIENCES

Performance Enabler No. 2

Explain and demonstrate the unloading of valves and circuits.

LEARNING ACTIVITIES

SPECIAL INSTRUCTIONS

Please Do Not Write Or Mark On This Guide

Read: Mobile Hydraulics Manual, pp. 83, 88, and 92.

Read: Industrial Hydraulics Technology, pp. 9-5 through 9-7, 10-2 through 10-4.

Answer the study questions in the Activity Manual, p. 25-1.

Set up Activity #25.

Turn in to your instructor.

Follow the procedure very carefully. Complete the worksheet and answer the activity questions.

Ask your instructor for help if needed.

(c) El Paso Community College, 1988

LEARNING EXPERIENCES

Performance Enabler No. 3

Explain and demonstrate the regeneration of circuits.

LEARNING ACTIVITIES

SPECIAL INSTRUCTIONS

Please Do Not Write Or Mark On This Guide

Read: Industrial Hydraulics Technology,
pp. 6-15 and 6-16.

Answer the study questions in the
Activity Manual, p. 26-1.

Set up Activity #26.

Turn in to your in-
structor.

Follow the pro-
cedure very care-
fully. Complete the
worksheet and answer
the activity ques-
tions.

Ask your instructor
for help if needed.

LEARNING EXPERIENCES

Performance Enabler No. 4

Explain and demonstrate remote control in hydraulic circuits.

LEARNING ACTIVITIES

SPECIAL INSTRUCTIONS

Please Do Not Write Or Mark On This Guide

Read: Industrial Hydraulics Technology,
pp. 8-4 and 8-5.

Answer the study questions in the
Activity Manual, pp. 27-1 and 27-2.

Set up Activity #27.

Turn in to your in-
structor.

Follow the pro-
cedure very care-
fully. Complete the
worksheet and answer
the activity ques-
tions.

Ask your instructor
for help if needed.

(c) El Paso Community College, 1988

STUDENT LEARNING GUIDE

**Advanced Industrial Technology Training Center
c/o El Paso Community College
P.O. Box 20500
El Paso, Texas 79998**

COURSE NUMBER AND TITLE: Hydraulics III

DUTY/UNIT: Actuators and Troubleshooting

COMPETENCY NUMBER: 3

COMPETENCY: EXPLAIN ACTUATORS, FILTRATION & TROUBLESHOOTING

INTRODUCTION:

This unit covers actuators, fluid filtration, and troubleshooting of hydraulic circuits. This is the final unit of hydraulics. Testing is by use of a lab trainer.

PERFORMANCE OBJECTIVE:

Given access to a hydraulic trainer device, demonstrate the correct operation of actuators, fluid filtration, and troubleshooting of hydraulic circuits.

PERFORMANCE ENABLERS:

1. Demonstrate how braking valves affect circuit conditions.
2. Explain maintenance considerations for hydraulic systems.
3. Explain and demonstrate the troubleshooting of hydraulic circuits.

Please Do Not Write Or Mark On This Guide

(c) El Paso Community College, 1988

LEARNING EXPERIENCES

Performance Enabler No. 1

Demonstrate how braking valves affect circuit conditions.

LEARNING ACTIVITIES

SPECIAL INSTRUCTIONS

Please Do Not Write Or Mark On This Guide

Read: Mobile Hydraulics Manual, p. 91.

Read: Industrial Hydraulics Technology,
pp. 6-10, 8-15, 9-2, 9-6, 9-7, 12-9,
12-10, 12-11.

Answer the study questions in the
Activity Manual, pp. 28-1 and 28-2.

Set up Activity #28.

Turn in to your in-
structor.

Follow the pro-
cedure very care-
fully. Complete the
worksheet and answer
the activity ques-
tions.

Ask your instructor
for help if needed.

LEARNING EXPERIENCES

Performance Enabler No. 2

Explain maintenance considerations for hydraulic systems.

LEARNING ACTIVITIES

SPECIAL INSTRUCTIONS

Please Do Not Write Or Mark On This Guide

Read: Mobile Hydraulics Manual, pp. 26-32.

Read: Industrial Hydraulics Technology, pp. 13-6 through 13-17.

Answer the study questions in the Activity Manual, p. 29-1.

Complete worksheet.

Turn in to your instructor.

Answer the activity questions and turn them in to your instructor.

Ask your instructor for help if needed.

(c) El Paso Community College, 1988

LEARNING EXPERIENCES

Performance Enabler No. 3

Explain and demonstrate the troubleshooting of hydraulic circuits.

LEARNING ACTIVITIES

SPECIAL INSTRUCTIONS

Please Do Not Write Or Mark On This Guide

Read: Activity Manual, pp. 30-1, 30-2.

Answer the study questions in the Activity Manual, p. 30-2.

Set up Activity #30.

Turn in to your instructor.

Follow the procedure very carefully. Complete the worksheet and answer the activity questions.

Ask your instructor for help if needed.

(c) El Paso Community College, 1988

OFFICIAL COURSE OUTLINE

Subject Area: Industrial Maintenance Mechanic
Course Number:
Course Title: Print Reading for Machine Trades
Course Hours:

I. Catalog Description:

This course explores the uses of blueprints to communicate information in industry. It expands on the correct alphabet of lines. Sketching is introduced early, allowing the student to become familiar with basic drafting. The course teaches math along with nonprecision and precision measuring. Metric conventions and prints are introduced. The course covers the key conventions, symbols, and abbreviations found in today's industry.

II. Course Objectives

Upon satisfactory completion of this course, the student will be able to:

- A. Communicate through the use of prints.
- B. Identify and explain the information found on a print.
- C. Recognize different types of lines used on drawings.
- D. Understand simple working drawings.
- E. Develop the skill of sketching objects freehand.
- F. Display knowledge of nonprecision and precision measurements and uses of drawing scales.
- G. Review basic shop operations.

(Continued...)

- H. Interpret basic dimensioning practices.
- I. Recognize the different kinds of tolerancing to mechanical dimensions.
- J. Recognize the different views used in drawings.
- K. Identify and interpret the different kinds of fasteners specified on drawings.
- L. Identify the surface finish requirements of a drawing.
- M. Recognize and interpret conventional drafting practices.

III. Unit Titles

Unit I — Industry's Means of Communication. This unit introduces the importance of drawings in industry. It shows the information the mechanic will receive from a drawing. Emphasis is on the alphabet of lines, orthographic projections, freehand drawings, and pictorial drawings.

Unit II — Using Correct Measurements. This unit introduces the correct way to measure and draw per industry standards. Math as used by the mechanic will also be reviewed. This unit covers drawing scales, dimensions, dimensioning holes, and limits and tolerances.

Unit III — Drawing Views. This unit introduces the study of auxiliary views, section views, and threads and fasteners.

Unit IV — Finish and practices. This unit introduces the student to the surface finish requirements of a drawing, while learning shortcuts used by drafters. Metric print reading presents an opportunity to relate basic metrics to everyday objects.

IV. Text and Materials

A. Required Textbook:

Riggs, Ronald D., Print Reading for Machine Shop, American Technical Publishers, Inc., 1981.
(Available in EPCC bookstore.)

(Continued...)

B. Materials:

1. Pencils
2. Notebook
3. One 6-inch steel rule in 1/32 and 1/64 inch

V. Instructor's Resources

A. Book:

Riggs, Ronald D., Print Reading for Machine Shop, American Technical Publishers, Inc., 1981.

B. Other Resources:

1. Library of Congress Number 81-67536
2. Marshall and Williams Company
3. James C. White Company

VI. Evaluation Measures

Self-check quizzes	—	40% of final grade
Unit Exercises	—	<u>60% of final grade</u>
TOTAL		100%

GRADING SCALE

90 - 100	A
80 - 89	B
70 - 79	C
60 - 69	D
0 - 59	F

All self-check quizzes and Unit Exercises are contained in the student's book.

Grades of I (Incomplete) and W (Withdraw) will be given in accordance with current College policy.

PERFORMANCE TEST 1

In the process of using blueprint communications, the student will:

1. Sketch several possible front view of each top view, using the examples given.
2. Use the exercise "Freehand Sketching" at the end of the text.

PERFORMANCE TEST 2

In the process of using correct measurements, the student will:

1. Use the exercise "Oblique Isometric Sketch" at the back of the text.
2. Use a 1:1 scale and maintain good proportions.
3. Make an oblique and an isometric sketch of the bracket shown in exercise 13-1 on page 106 of the text.

PERFORMANCE TEST 3

In the process of getting the necessary information from the drawing, the student will:

1. Use the prints furnished.
2. Answer the questions about each print.

(Continued...)

PERFORMANCE TEST 4

In the process of reading a blueprint, the student will:

1. Use information from the furnished prints.
2. Answer the questions pertaining to the print.

PERFORMANCE TEST 5

In the process of understanding finishes, the student will:

1. Answer the questions pertaining to the print.
2. Use the print on plate and bushings.

PERFORMANCE TEST 6

In the process of reading a print correctly, the student will:

1. Use the print "Jaw, Fixed Print."
2. Answer the questions pertaining to the print.

PERFORMANCE TEST 7

In the process of final print reading, the student will:

1. Use the print "Speed Reducer Assay."
2. Answer the questions that are asked about the print.

STUDENT LEARNING GUIDE

**Advanced Industrial Technology Training Center
c/o El Paso Community College
P.O. Box 20500
El Paso, Texas 79998**

COURSE NUMBER AND TITLE: Print Reading for Machine Trades

DUTY/UNIT: Industry's Means of Communication

COMPETENCY NUMBER: 1

COMPETENCY: UTILIZE INDUSTRY'S MEANS OF COMMUNICATION

INTRODUCTION:

This unit introduces the importance of drawings in industry. It shows the information the mechanic will receive from a drawing. Emphasis is placed on the alphabet of lines, orthographic projections, freehand drawings, and pictorial drawings.

PERFORMANCE OBJECTIVE:

Given access to the text and help from the instructor, learn and utilize industry's means of communication.

PERFORMANCE ENABLERS:

1. Communicate through the use of prints.
2. Locate the information found on a print.
3. Show an understanding of lines used on a drawing.
4. Project the surface of the object out to the viewing plane.
5. Communicate design ideas "on the job."
6. Recognize and develop drawings and sketches.

Please Do Not Write Or Mark On This Guide

(c) El Paso Community College, 1988

LEARNING EXPERIENCES

Performance Enabler No. 1

Communicate through the use of prints.

LEARNING ACTIVITIES

SPECIAL INSTRUCTIONS

Please Do Not Write Or Mark On This Guide

Read: Unit I of the text.

Do: Self-check Quiz 1-a.

Ask your instructor
for help if needed.

(c) El Paso Community College, 1988

LEARNING EXPERIENCES

Performance Enabler No. 2

Locate the information found on a print.

LEARNING ACTIVITIES

SPECIAL INSTRUCTIONS

Please Do Not Write Or Mark On This Guide

Read: Unit II of the text.

Do: Self-check Quizzes 2-a and 2-b.

Do: Unit Exercise 2-1.

Ask your instructor
for help if needed.

Have your instructor
check the exercises
before going to the
next unit.

(c) El Paso Community College, 1988

LEARNING EXPERIENCES

Performance Enabler No. 3

Show an understanding of the different lines used on a drawing.

LEARNING ACTIVITIES

SPECIAL INSTRUCTIONS

Please Do Not Write Or Mark On This Guide

Read: Unit III of the text.

Do: Self-check Quizzes 3-a and 3-b.

Do: Unit Exercises 3-1 and 3-2.

Ask your instructor
for help if needed.

Have your instructor
check the exercises
before going on.

(c) El Paso Community College, 1988

LEARNING EXPERIENCES

Performance Enabler No. 4

Project the surface of the object out to the viewing plane.

LEARNING ACTIVITIES

SPECIAL INSTRUCTIONS

Please Do Not Write Or Mark On This Guide

Read: Unit IV of the text.

Do: Self-check Quizzes 4-a and 4-b.

Do: Unit Exercises 4-1, 4-2, 4-3, and 4-4.

Ask your instructor
for help if needed.

Have your instructor
check the exercises
before going on.

(c) El Paso Community College, 1988

LEARNING EXPERIENCES

Performance Enabler No. 5.

Communicate design ideas "on the job."

LEARNING ACTIVITIES

SPECIAL INSTRUCTIONS

Please Do Not Write Or Mark On This Guide

Read: Unit V of the text.

Do: Self-check Quiz 5-a.

Do: Unit Exercises 5-1, 5-2, 5-3, and 5-4.

Do: Performance Test 1: Freehand Sketching.

Ask your instructor for help if needed.

Have your instructor check the exercises before going on.

This test is at the back of your text. Give it to your instructor for grading.

(c) El Paso Community College, 1988

LEARNING EXPERIENCES

Performance Enabler No. 6

Recognize and develop drawings and sketches.

LEARNING ACTIVITIES

SPECIAL INSTRUCTIONS

Please Do Not Write Or Mark On This Guide

Read: Unit VI of the text.

Do: Self-check Quiz 6-a.

Do: Unit Exercises 6-1, 6-2, and 6-3.

Ask your instructor
for help if needed.

Have your instructor
check the unit ex-
ercises before going
on.

STUDENT LEARNING GUIDE

**Advanced Industrial Technology Training Center
c/o El Paso Community College
P.O. Box 20500
El Paso, Texas 79998**

COURSE NUMBER AND TITLE: Print Reading for Machine Trades

DUTY/UNIT: Using Correct Measurements

COMPETENCY NUMBER: 2

COMPETENCY: UTILIZE CORRECT MEASUREMENTS FOR PRINT READING

INTRODUCTION:

This guide introduces the correct way to measure and draw per industry standards. Math as used by the mechanic will be reviewed. This guide covers drawing scales, dimensions, dimensioning holes, and limits and tolerances.

PERFORMANCE OBJECTIVE:

Given access to the text and help from the instructor, utilize correct measurements for print reading.

PERFORMANCE ENABLERS:

1. Solve basic shop math problems as used by industry.
2. Correctly use the steel rule to draw objects to the correct scale.
3. Correctly use the vernier and micrometer calipers.
4. Correctly apply tolerances and dimensions.

Please Do Not Write Or Mark On This Guide

(c) El Paso Community College, 1988

LEARNING EXPERIENCES

Performance Enabler No. 1

Solve basic shop math problems as used by industry.

LEARNING ACTIVITIES

SPECIAL INSTRUCTIONS

Please Do Not Write Or Mark On This Guide

Read: Unit 8 of the text.

Do: Self-check Quizzes 8-a, 8-b, 8-c,
8-d, and 8-e.

Do: Unit Exercises 8-1, 8-2, and 8-3.

Ask your instructor
for help if needed.

Have your instructor
check your exercises
before going on.

(c) El Paso Community College, 1988

LEARNING EXPERIENCES

Performance Enabler No. 2

Correctly use the steel rule to draw objects to the correct scale.

LEARNING ACTIVITIES

SPECIAL INSTRUCTIONS

Please Do Not Write Or Mark On This Guide

Read: Unit 7 of the text.

Do: Self-check Quizzes 7-a and 7-b.

Do: Unit Exercise 7-1.

Do: Performance Test 2, "Oblique Isometric Sketch."

Ask your instructor for help if needed.

Have your instructor check the exercise before going on.

This test is at the back of your book. Turn it in to your instructor for grading.

(c) El Paso Community College, 1988

LEARNING EXPERIENCES

Performance Enabler No. 3

Correctly use the vernier and micrometer calipers.

LEARNING ACTIVITIES

SPECIAL INSTRUCTIONS

Please Do Not Write Or Mark On This Guide

Check out a vernier caliper from the tool crib.

Have your instructor explain the correct way to read the caliper.

This is a hands-on exercise with your instructor.

Check out a micrometer caliper from the tool crib.

Same as above.

(c) El Paso Community College, 1988

LEARNING EXPERIENCES

Performance Enabler No. 4

Correctly apply tolerances and dimensions.

LEARNING ACTIVITIES

SPECIAL INSTRUCTIONS

Please Do Not Write Or Mark On This Guide

Read: Unit 9 of the text.

Do: Self-check Quizzes 9-a and 9-b.

Do: Unit Exercises 9-1 and 9-2.

Read: Unit 10 of the text.

Do: Self-check Quizzes 10-a and 10-b.

Do: Unit Exercises 10-1, 10-2, and 10-3.

Read: Unit 11 of the text.

Do: Self-check Quiz 11-a.

Do: Unit Exercise 11-1.

Ask your instructor
for help if needed.

Have your instructor
check the exercises.

Same as above.

Same as above.

Same as above.

Same as above.

(c) El Paso Community College, 1988

STUDENT LEARNING GUIDE

**Advanced Industrial Technology Training Center
c/o El Paso Community College
P.O. Box 20500
El Paso, Texas 79998**

COURSE NUMBER AND TITLE: Print Reading for Machine Trades

DUTY/UNIT: Drawing Views

COMPETENCY NUMBER: 3

COMPETENCY: INTERPRET DIFFERENT DRAWING VIEWS

INTRODUCTION:

This guide introduces auxiliary views, section views, threads, and fasteners.

PERFORMANCE OBJECTIVE:

Given appropriate instruction, interpret auxiliary views, section views, and symbols for threads and fasteners.

PERFORMANCE ENABLERS:

1. Explain how the different views help the blueprint reader to better understand a complicated object.
2. Explain why an inclined surface appears distorted in the normal view.
3. Define and categorize threads and fasteners and the symbols used to show them on a print.

Please Do Not Write Or Mark On This Guide

(c) El Paso Community College, 1988

LEARNING EXPERIENCES

Performance Enabler No. 1

Explain how the different views help the blueprint reader to better understand a complicated object.

LEARNING ACTIVITIES	SPECIAL INSTRUCTIONS		
Please Do Not Write Or Mark On This Guide <table><tr><td data-bbox="234 639 940 1651"> Read: Unit 12 of the text. Do: Self-check Quizzes 12-a and 12-b. Do: Unit Exercises 12-1, 12-2, and 12-3. Do: Performance Test 3, "Print Information." </td><td data-bbox="940 639 1353 1651"> Ask your instructor for help if needed. Have your instructor check the exercises before going on. This test is at the back of your text. Give it to your instructor for grading. </td></tr></table>		Read: Unit 12 of the text. Do: Self-check Quizzes 12-a and 12-b. Do: Unit Exercises 12-1, 12-2, and 12-3. Do: Performance Test 3, "Print Information."	Ask your instructor for help if needed. Have your instructor check the exercises before going on. This test is at the back of your text. Give it to your instructor for grading.
Read: Unit 12 of the text. Do: Self-check Quizzes 12-a and 12-b. Do: Unit Exercises 12-1, 12-2, and 12-3. Do: Performance Test 3, "Print Information."	Ask your instructor for help if needed. Have your instructor check the exercises before going on. This test is at the back of your text. Give it to your instructor for grading.		

(c) El Paso Community College, 1988

LEARNING EXPERIENCES

Performance Enabler No. 2

Explain why an inclined surface appears distorted in the normal view.

LEARNING ACTIVITIES

SPECIAL INSTRUCTIONS

Please Do Not Write Or Mark On This Guide

Read: Unit 13 of the text.

Do: Self-check Quiz 13-a.

Do: Unit Exercises 13-1 and 13-2.

Ask your instructor
for help if needed.

Have your instructor
check the exercises
before going on.

(c) El Paso Community College, 1988

LEARNING EXPERIENCES

Performance Enabler No. 3

Define and categorize threads and fasteners and the symbols used to show them on a print.

LEARNING ACTIVITIES

SPECIAL INSTRUCTIONS

Please Do Not Write Or Mark On This Guide

Read: Unit 14 of the text.

Do: Self-check Quiz 14-a.

Do: Unit Exercise 14-1.

Ask your instructor
for help if needed.

Have the instructor
check the exercise
before going on.

(c) El Paso Community College, 1988

STUDENT LEARNING GUIDE ,

Advanced Industrial Technology Training Center
c/o El Paso Community College
P.O. Box 20500
El Paso, Texas 79998

COURSE NUMBER AND TITLE: Print Reading for Machine Trades

DUTY/UNIT: Finish and Practices

COMPETENCY NUMBER: 4

COMPETENCY: IDENTIFY BLUEPRINT FINISHES AND PRACTICES

INTRODUCTION:

This guide introduces the surface finish requirements of a drawing. It also shows shortcuts used by drafters. Metric print reading presents an opportunity to relate basic metrics to everyday objects.

PERFORMANCE OBJECTIVE:

Given access to the text and help from the instructor, identify the finishes and practices of blueprints.

PERFORMANCE ENABLERS:

1. Show that many different processes are used to machine parts shown on a drawing.
2. Show that drafters use many shortcuts (drafting practices) to save time.
3. Show how the metric system is used in industry.

Please Do Not Write Or Mark On This Guide

(c) El Paso Community College, 1988

LEARNING EXPERIENCES

Performance Enabler No. 1

Show that many different processes are used to machine parts shown on a drawing.

LEARNING ACTIVITIES

SPECIAL INSTRUCTIONS

Please Do Not Write Or Mark On This Guide

Read: Unit 15 of the text.

Do: All Self-check Quizzes for the unit.

Do: Unit Exercise 15-1.

Do: Performance Test 4, "Drawing Rear Jaw."

Ask your instructor for help if needed.

Have your instructor check the exercise before going on.

This test is at the back of your text. Give it to your instructor for grading.

(c) El Paso Community College, 1988

LEARNING EXPERIENCES

Performance Enabler No. 2

Show that drafters use many shortcuts (drafting practices) to save time.

LEARNING ACTIVITIES

SPECIAL INSTRUCTIONS

Please Do Not Write Or Mark On This Guide

Read: Unit 16 of the text.

Do: All Self-check Quizzes for the unit.

Do: Unit Exercises 16-1 and 16-2.

Do: Performance Test 5, "Surfaces and Dimensions."

Do: Performance Test 6, "Jaw, Fixed Print."

Ask your instructor for help if needed.

Have your instructor check the exercises before going on.

This test is at the back of your text. Give it to your instructor for grading.

Same as above.

(c) El Paso Community College, 1988

LEARNING EXPERIENCES

Performance Enabler No. 3

Show how the metric system is used in industry.

LEARNING ACTIVITIES

SPECIAL INSTRUCTIONS

Please Do Not Write Or Mark On This Guide

Read: Unit 17 of text.

Do: Self-check Quizzes 17-a and 17-b.

Do: Unit Exercises 17-1 and 17-2.

Do: Performance Test 7, "Speed Reducer Assay."

Ask your instructor for help if needed.

Have your instructor check your exercises.

This test is at the back of your text. Give it to your instructor.

This is the last enabler of Print Reading for Machine Trades.

(c) El Paso Community College. 1988

OFFICIAL COURSE OUTLINE

Subject Area: Industrial Maintenance Mechanic
Code/Course Number:
Course Title: Mechanical Maintenance
Course Hours:

I. Catalog Description

This course is intended to guide a practical student in solving problems which present themselves on a daily basis in the construction and operation of industrial plants. It provides the student with a basic knowledge of the major areas of equipment maintenance. Many areas are covered; each is important in the maintenance of any piece of equipment or machinery, large or small.

II. Course Objectives

Upon satisfactory completion of this course, the student will be able to:

- A. Demonstrate knowledge of machinery installation.
- B. Demonstrate knowledge of mechanical power.
- C. Demonstrate knowledge of hand tools and their functions.
- D. Demonstrate the uses of V-belt drives.
- E. Demonstrate the uses of flat belts.
- F. Demonstrate the uses of gears.
- G. Demonstrate chain drives.
- H. Demonstrate couplings.
- I. Demonstrate the proper uses of packing and seals.
- J. Demonstrate the uses of bearings and proper care.
- K. Demonstrate fabrication of structural steel in industry setting.

(Continued...)

- L. Demonstrate the making of external and internal threads.
- M. Demonstrate the making of the proper mechanical fastener for the assigned job.
- N. Demonstrate the making of a water system.
- O. Demonstrate the correct way to maintain valves in the system.
- P. Demonstrate troubleshooting of electricity.
- Q. Demonstrate the repair of pumps and how they work.

III. Unit Titles

Unit I — Basic Mechanical Introduction. This unit introduces the importance of the layout of machinery and the hardware needed to do the operation correctly. The proper selection and care of hand tools are very important to the mechanic as is the practical knowledge of the daily work procedure.

Unit II — Power Transmission. This unit introduces the ways that are used by industry to transmit power in modern machinery. The unit will cover belts, chains, and couplings.

Unit III — Support Hardware. This unit introduces the styles and types of packing and seals, bearings and how they are used. The uses of structural steel in modern industry are also covered.

Unit IV — Mechanical Maintenance. This unit introduces the fasteners used in the machinery of industry today and the correct uses of pipe and valves used throughout the mechanical field of modern industry.

Unit V — Electricity and Pumps. The knowledge of electricity is very important to the industrial mechanic. The need to have a working knowledge has grown year by year. Pumps are used by every type of production operation. The mechanic must be able to repair pumps to keep production moving.

(Continued...)

IV. Text and Materials

A. Required Textbook:

Nelson, Carl A., Millwright And Mechanics Guide,
The Bobbs-Merrill Company, Inc., 1983.
(Available in EPCC bookstore.)

B. Materials:

1. Pen or pencil (student choice)
2. Notebook (student choice)
3. Safety glasses which meet OSHA standards

V. Instructor's Resources

A. Books:

Nelson, Carl A., Millwright And Mechanics Guide,
The Bobbs-Merrill Company, Inc., 1983.

Wireman, Terry. Industrial Maintenance, Reston
Publishing Company, Inc., 1983.

B. Filmstrips:

Tel-A-Train, Mechanical

VI. Evaluation Measures

Performance Tests	—	50% of final grade
Lab Assignments	—	50% of final grade
TOTAL		100%

GRADING SCALE

90 - 100	A
80 - 89	B
70 - 79	C
60 - 69	D
0 - 59	F

The grades of I (Incomplete) and W (Withdraw) will be given
in accordance with current College policy.

STUDENT LEARNING GUIDE

Advanced Industrial Technology Training Center
c/o El Paso Community College
P.O. Box 20500
El Paso, Texas 79998

COURSE NUMBER AND TITLE: Mechanical Maintenance

DUTY/UNIT: Basic Mechanical Introduction

COMPETENCY NUMBER: 1

COMPETENCY: LAY OUT AND IDENTIFY TOOLS BY THEIR PROPER NAME

INTRODUCTION:

This unit introduces the importance of the layout of machinery, as well as the hardware needed to do the operation correctly. The proper selection and care of hand tools are very important to the mechanic, as is the practical knowledge of the daily work procedure.

PERFORMANCE OBJECTIVE:

Given access to machinery and tools, set up equipment and identify tools by their proper names.

PERFORMANCE ENABLERS:

1. Demonstrate knowledge of machinery installation.
2. Demonstrate knowledge of mechanical power.
3. Demonstrate knowledge of hand tools and their function.

Please Do Not Write Or Mark On This Guide

(c) El Paso Community College, 1988

LEARNING EXPERIENCES

Performance Enabler No. 1

Demonstrate knowledge of machinery installation.

LEARNING ACTIVITIES

SPECIAL INSTRUCTIONS

Please Do Not Write Or Mark On This Guide

Review: Millwright and Mechanic's Guide,
"Drawing and Sketching," pp. 11-50.
This will help you as you go on to the
rest of the text.

Read: Millwright and Mechanic's Guide,
pp. 51-58.

View: "Basic Terms of Maintenance"
videotape.

Demonstrate the methods of laying the
base lines, using both methods.

Demonstrate the methods of leveling
machinery.

Ask your instructor
for the test cover-
ing the videotape.

Ask your instructor
for the machine for
which you will lay
base lines.

Ask your instructor
for the machine to
be leveled.

(c) El Paso Community College, 1988

LEARNING EXPERIENCES

Performance Enabler No. 2

Demonstrate knowledge of mechanical power.

LEARNING ACTIVITIES

SPECIAL INSTRUCTIONS

Please Do Not Write Or Mark On This Guide

Read: Millwright and Mechanic's Guide,
pp. 89-96, "Principles of Mechanical
Power."

Demonstrate how to find shaft speed
and pitch.

To check your knowledge of the princi-
ples of mechanical power, write a paper
highlighting pitch, shaft speed, and
pitch diameter.

Familiarize yourself
with the terms used
in this chapter.

Ask your instructor
for a machine to de-
monstrate with.

LEARNING EXPERIENCES

Performance Enabler No. 3

Demonstrate knowledge of hand tools and their function.

LEARNING ACTIVITIES

SPECIAL INSTRUCTIONS

Please Do Not Write Or Mark On This Guide

Study hand tools and their function.

View: Films on hand tool safety.

Using tools in the
crib, and with the
instructor's help,
learn the proper
names and functions.

Ask your instructor
if more help is
needed.

(c) El Paso Community College, 1988

SELF-CHECK

DIRECTIONS

Complete each self-check section after finishing the appropriate enabler.

Please Do Not Write Or Mark On This Guide

1 - Demonstrate knowledge of machinery installation.

1. Know the methods of developing lines.
2. Know the fundamental requirements common to all machinery foundations.
3. Know the general construction of heavy machinery foundations.
4. Know the fundamental requirements of a foundation bolt.
5. Know the various types of special machine mounts.
6. Know the steps in leveling objects accurately.

2 - Demonstrate knowledge of mechanical power.

1. Know how to find driving shaft speed.
2. Know how to find driven shaft speed.
3. Know how to find driving pitch diameter.
4. Know how to find driven pitch diameter.

3 - Demonstrate knowledge of hand tools and their function.

1. Know the styles of wrenches and their functions.
2. Know the styles of hammers and their functions.
3. Know the styles of screwdrivers and their correct uses.
4. Know the styles of sockets.
5. Know the styles of files and their correct uses.
6. Know the correct selection of drill bits.
7. Know the styles of pliers.
8. Know the styles of punches and their uses.
9. Know the uses of taps and dies.
10. Know how to use extractors.

PERFORMANCE TEST

STUDENT'S NAME

DATE

COMPETENCY NUMBER AND STATEMENT

TEST ATTEMPT

- 1 - Lay out and identify tools
by proper name.

1ST 2ND 3RD

DIRECTIONS

(See below)

OVERALL EVALUATION:

PERFORMANCE LEVELS

- 4 Can perform this skill
without supervision and with
initiative and adaptability to
problem situations.
3 Can perform this skill
satisfactorily without
assistance or supervision.
2 Can perform this skill
satisfactorily but requires
some assistance and/or
supervision.
1 Can perform parts of this
skill satisfactorily but
requires considerable
assistance and/or supervision.
0 Cannot perform this skill.

PERFORMANCE STANDARDS

For acceptable achievement, all items should receive a "yes" or "not applicable" response.

	YES	NO	NOT APPL.
1 - <u>Machine Installation</u>			
1. Locate base lines.			
2. Follow the three steps of arc method.			
3. Follow the steps of 3-4-5 method.			
2 - <u>Machine Leveling</u>			
4. Correct selection of tools.			
5. Follow the steps for first-time accuracy.			
6. Use a precision level for leveling.			
(Continued...)			

PERFORMANCE TEST (CONT.)

PERFORMANCE STANDARDS

FOR ACCEPTABLE ACHIEVEMENT, ALL ITEMS SHOULD RECEIVE A "YES" OR "NOT APPLICABLE" RESPONSE
YES NO NOT APPL.

In the process of demonstrating shaft speed and pitch, the student:

1. Found the correct distance from a point to a corresponding point.
2. Found driving shaft speed.
3. Found driven shaft speed.
4. Found driving pitch diameter.
5. Found driven pitch diameter.

Complete the performance test handout for Competency #1 given to you by your instructor.

Please Do Not Write Or Mark On This Guide

STUDENT LEARNING GUIDE

Advanced Industrial Technology Training Center
c/o El Paso Community College
P.O. Box 20500
El Paso, Texas 79998

COURSE NUMBER AND TITLE: Mechanical Maintenance

DUTY/UNIT: Power Transmission

COMPETENCY NUMBER: 2

COMPETENCY: MAKE INSTALLATIONS, ALIGNMENTS, AND ADJUSTMENTS

INTRODUCTION:

This unit introduces the ways that are used by industry to transmit power in modern machinery. The unit will cover belts, chains, and couplings.

PERFORMANCE OBJECTIVE:

Given access to a mechanical trainer or actual machines, make installations, alignments, and adjustments.

PERFORMANCE ENABLERS:

1. Demonstrate the uses of V-belt drives.
2. Demonstrate the uses of flat belts.
3. Demonstrate the uses of gears.
4. Demonstrate chain drives.
5. Demonstrate couplings.

Please Do Not Write Or Mark On This Guide

(c) El Paso Community College, 1988

LEARNING EXPERIENCES

Performance Enabler No. 1

Demonstrate the uses of V-belt drives.

LEARNING ACTIVITIES

SPECIAL INSTRUCTIONS

Please Do Not Write Or Mark On This Guide

Read: Millwright and Mechanic's Guide,
pp. 97-123, "V-belt Drives."

View: "Maintaining V-belts."

Set up and demonstrate V-belts as per
instructor.

Ask your instructor
if any help is
needed.

Follow belt instal-
lation step by step
and complete as per
instructor.

If help is needed,
ask your instructor.

(c) El Paso Community College, 1988

LEARNING EXPERIENCES

Performance Enabler No. 2.

Demonstrate the uses of flat belts.

LEARNING ACTIVITIES

SPECIAL INSTRUCTIONS

Please Do Not Write Or Mark On This Guide

Read: Millwright and Mechanic's Guide,
pp. 125-157, "Flat Belts."

View: Videotape "Timing Belts and
Flat Belts."

Take test after viewing the tape.

Demonstrate the proper installation of
flat belts.

Ask your instructor
if help is needed.

Ask your instructor
for the test sheet.

Use a trainer or a
machine assigned by
your instructor.

LEARNING EXPERIENCES

Performance Enabler No. 3

Demonstrate the uses of gears.

LEARNING ACTIVITIES

SPECIAL INSTRUCTIONS

Please Do Not Write Or Mark On This Guide

Read: Millwright and Mechanic's Guide,
pp. 159-178.

View: Videotape "Gearing."

View: Videotape "Reducers and Gear-
motors."

Set up and demonstrate the spur gear.

Set up and demonstrate the rack-and-
pinion gear.

Set up and demonstrate the worm gear.

Ask your instructor
for help if needed.

Ask your instructor
for help if needed.

If you have any
doubts, view the
films once again.

LEARNING EXPERIENCES

Performance Enabler No. 4

Demonstrate chain drives.

LEARNING ACTIVITIES

SPECIAL INSTRUCTIONS

Please Do Not Write Or Mark On This Guide

Read: Millwright and Mechanic's Guide,
pp. 179-206.

View: Videotape "Roller Chain."

View: Videotape "Chain Other Than
Roller Chain."

Set up and demonstrate roller chain.

Set up and demonstrate silent chain.

Ask your instructor
to help you set up
if needed.

Use trainer or mach-
ine assigned by your
instructor.

Same as above.

Ask your instructor
if help is needed at
any time.

(c) El Paso Community College, 1988

LEARNING EXPERIENCES

Performance Enabler No. 5

Demonstrate coupling.

LEARNING ACTIVITIES

SPECIAL INSTRUCTIONS

Please Do Not Write Or Mark On This Guide

Read: Millwright and Mechanic's Guide,
pp. 207-231.

View: Videotape "Couplings."

View: Videotape "Aligning Couplings
(Part 1): Feeler Gauge."

View: Videotape "Aligning Couplings
(Part 2): Dial Indicator."

Set up and demonstrate a rigid coupling.

Set up and demonstrate a flexible
coupling.

Set up and demonstrate a chain-and-
gear coupling.

Use a feeler gauge
and dial indicator
method.

Use dial indicator
method.

Use straightedge and
feeler gauge method.

(c) El Paso Community College, 1988

SELF-CHECK

DIRECTIONS

Complete each section of the self-check test after finishing the appropriate enabler.

Please Do Not Write Or Mark On This Guide

1 - Demonstrate the uses of V-belt drives.

1. Know the three general classifications of V-belts.
2. Know the most frequent causes of shortened belt life.
3. Know how to match V-belts.
4. Know the proper installation of V-belts.
5. Know the general rules of V-belt installation.
6. Know the way to check belt tension.
7. Know proper selection of V-belts.
8. Know the proper maintenance of V-belts.

2 - Demonstrate the uses of flat belts.

1. Know the materials flat belts are made of.
2. Know how to find belt speed.
3. Know the difference between belt creep and slip.
4. Know the methods of balance testing a pulley.
5. Know how to find belt length.
6. Know the methods of making belt joints.
7. Know how to install belts on pulleys.
8. Know drive arrangements.
9. Know belt maintenance.
10. Know the construction of pulleys.
11. Know how to align pulleys and shafting.

3 - Demonstrate the uses of gears.

1. Know the types of gears used in machinery.
2. Know how to find pitch diameter and center distance.
3. Know how to find diametral pitch approximation.
4. Know the parts of a gear.
5. Know what backlash is.
6. Know how to install and align gears.

(Continued...)

SELF-CHECK (CONT.)

4 - Demonstrate chain drives.

1. Know the parts of a chain drive.
2. Know the principal dimensions of roller chain.
3. Know how to find chain size.
4. Know the standard sprocket hubs.
5. Know roller chain installation.
6. Know the proper ways to lubricate chain.
7. Know the proper maintenance of chain drives.
8. Know the correct way to install chain drives.

5 - Demonstrate coupling.

1. Know the classifications of couplings.
2. Know how to install a rigid coupling, using both methods.
3. Know the types of flexibility that flexible couplings are designed to compensate for.
4. Know how to install a flexible coupling.
5. Know how to install a chain-and-gear coupling.
6. Know the alignment operations.

PERFORMANCE TEST

STUDENT'S NAME

DATE

COMPETENCY NUMBER AND STATEMENT

TEST ATTEMPT

2 - Make installations, alignments,
and adjustments.

1ST 2ND 3RD

DIRECTIONS

(See below)

OVERALL EVALUATION:

PERFORMANCE LEVELS

- 4 Can perform this skill without supervision and with initiative and adaptability to problem situations.
- 3 Can perform this skill satisfactorily without assistance or supervision.
- 2 Can perform this skill satisfactorily but requires some assistance and/or supervision.
- 1 Can perform parts of this skill satisfactorily but requires considerable assistance and/or supervision.
- 0 Cannot perform this skill.

PERFORMANCE STANDARDS

For acceptable achievement, all items should receive a "yes" or "not applicable" response.

	YES	NO	NOT APPL.
In the process of setting of V-belts, the student:			
1. Aligned V-belt drive.			
2. Installed V-belt, using the general rules.			
3. Checked for correct tension.			
4. Performed V-belt maintenance.			
(Continued...)			

PERFORMANCE TEST (CONT.)

PERFORMANCE STANDARDS

FOR ACCEPTABLE ACHIEVEMENT, ALL ITEMS SHOULD RECEIVE A "YES" OR "NOT APPLICABLE" RESPONSE

YES NO NOT APPL.

In the process of demonstrating flat belts, the student:

1. Set up and aligned shafts and pulleys.
2. Installed and aligned flat belts.
3. Constructed a belt joint.
4. Performed maintenance on flat belts.

In the process of installing gears, the student:

1. Installed the correct toothed gears.
2. Aligned gears properly.
3. Performed proper maintenance of gears.
4. Listed the parts of a gear.
5. Listed the different types of gears.

In the process of setting up and demonstrating chain drives, the student:

1. Selected the proper chain.
2. Selected the proper sprockets.
3. Installed chain using correct steps.
4. Aligned chain drive.
5. Adjusted chain drive.
6. Conducted drive chain maintenance.
7. Lubricated chain drive.

In the process of setting up the selected couplings, the student:

1. Selected the correct couplings.
2. Conducted proper installation of the coupling.
3. Demonstrated the methods for correct alignment of the selected couplings.

Please Do Not Write Or Mark On This Guide

STUDENT LEARNING GUIDE

**Advanced Industrial Technology Training Center
c/o El Paso Community College
P.O. Box 20500
El Paso, Texas 79998**

COURSE NUMBER AND TITLE: Mechanical Maintenance

DUTY/UNIT: Support Hardware

COMPETENCY NUMBER: 3

COMPETENCY: WORK WITH PACKING, SEALS, AND BEARINGS

INTRODUCTION:

This unit introduces the styles and types of packing, seals, and bearings, and how they are used. It also explains the use of structural steel in modern industry.

PERFORMANCE OBJECTIVE:

Given access to machinery, replace packing and seals, pack bearings, and explain the proper uses of steel.

PERFORMANCE ENABLERS:

1. Demonstrate the proper uses of packings and seals.
2. Demonstrate and explain the uses of bearings and their proper care.
3. Demonstrate and explain the fabrication of structural steel in the industrial setting.

Please Do Not Write Or Mark On This Guide

(c) El Paso Community College, 1988

LEARNING EXPERIENCES

Performance Enabler No. 1

Demonstrate the proper use of packings and seals.

LEARNING ACTIVITIES

SPECIAL INSTRUCTIONS

Please Do Not Write Or Mark On This Guide	
---	--

Read: Millwright and Mechanic's Guide,
pp. 233-276.

Demonstrate packing a stuffing box.

Demonstrate the correct use of O-rings.

Know the shapes and types of seals and packings. If you are having any problems, ask your instructor for help.

Follow the instructions given on pp. 241-242.

Follow the instructions on pp. 253-259.

This unit is very important, and you must have a working knowledge of each area.

LEARNING EXPERIENCES

Performance Enabler No. 2

Demonstrate and explain the use of bearings and their proper care.

LEARNING ACTIVITIES

SPECIAL INSTRUCTIONS

Please Do Not Write Or Mark On This Guide

Read: Millwright and Mechanic's Guide,
pp. 277-327.

View: Videotape "Maintaining Bearings."

Demonstrate the correct way to hand-pack
a bearing.

Demonstrate the mounting of a press fit
bearing.

Ask your instructor
for help if needed.

Ask your instructor
for the necessary
materials.

Use all safety pre-
cautions when press-
ing the bearing.

(c) El Paso Community College, 1988

LEARNING EXPERIENCES

Performance Enabler No. 3

Demonstrate and explain fabrication of structural steel in an industrial setting.

LEARNING ACTIVITIES

SPECIAL INSTRUCTIONS

Please Do Not Write Or Mark On This Guide

Read: Millwright and Mechanic's Guide,
pp. 329-350.

Develop a sketch of an A-frame using
the materials from this chapter.

Write a paper explaining the step-by-
step operation of your sketch. Don't
leave any operation out of your paper.

Ask your instructor
for help if needed.

Turn your work in to
your instructor for
a grade.

(c) El Paso Community College, 1988

SELF-CHECK

DIRECTIONS

Complete each self-check section after finishing your work on the appropriate enabler.

Please Do Not Write Or Mark On This Guide

1 - Demonstrate the proper uses of packings and seals.

1. Know the parts of a stuffing box.
2. Know the type of construction of compression packing.
3. Know the proper installation of all packings and seals.
4. Know the proper installation of mechanical seals.
5. Demonstrate packing a stuffing box.
6. Demonstrate the correct use of O-rings.

2 - Demonstrate and explain the uses of bearings and their proper care.

1. Know the classification of bearings.
2. Know the definitions given in connection with bearings and associated parts.
3. Know the common styles and types of plain bearings.
4. Know the proper handling of all bearing types.
5. Know where roller and ball bearings are used.
6. Know the proper lubrication of bearings.
7. Know the proper mounting procedures of bearings.

3 - Demonstrate and explain the fabrication of structural steel in an industrial setting.

1. Know the shapes used in structural steel.
 2. Know the terms used in structural steel.
 3. Know why clearance cuts are used.
 4. Know square-framed connections.
 5. Know terms of fabricating.
 6. Know steel elevation.
 7. Know angle connections.
 8. Know how to use a torque wrench to your advantage.
-
-

STUDENT LEARNING GUIDE

**Advanced Industrial Technology Training Center
c/o El Paso Community College
P.O. Box 20500
El Paso, Texas 79998**

COURSE NUMBER AND TITLE: Mechanical Maintenance

DUTY/UNIT: Fasteners and Piping Systems

COMPETENCY NUMBER: 4

COMPETENCY: MAKE FASTENERS & PIPING SYSTEMS TO STANDARDS

INTRODUCTION:

This unit introduces the fasteners used in the machinery of industry today and the correct uses of pipe and valves used throughout the mechanical field in modern industry.

PERFORMANCE OBJECTIVE:

Given access to the proper tools and materials, make fasteners and piping systems to industrial standards.

PERFORMANCE ENABLERS:

1. Demonstrate the making of external and internal threads.
2. Demonstrate the making of the proper mechanical fastener for the assigned job.
3. Demonstrate the making of a water system.
4. Demonstrate the correct way to maintain valves in the system.

Please Do Not Write Or Mark On This Guide

(c) El Paso Community College, 1988

LEARNING EXPERIENCES

Performance Enabler No. 1

Demonstrate the making of external and internal threads.

LEARNING ACTIVITIES

SPECIAL INSTRUCTIONS

Please Do Not Write Or Mark On This Guide

Read: Millwright and Mechanic's Guide,
pp. 351-370.

Demonstrate the making of external
threads.

Demonstrate the making of internal
threads.

Make three sizes of
each thread.

Make them to fit the
externally threaded
objects.

Ask your instructor
for help if needed.

(c) El Paso Community College, 1988

LEARNING EXPERIENCES

Performance Enabler No. 2

Demonstrate the making of the proper mechanical fastener for the assigned job.

LEARNING ACTIVITIES

SPECIAL INSTRUCTIONS

Please Do Not Write Or Mark On This Guide

Read: Millwright and Mechanic's Guide,
pp. 371-395.

Make a hook bolt with a right-angle
bend.

Make a hook bolt with a round bend.

Make a U-bolt with a square bend.

Make a U-bolt with a round bend.

Thread the correct
end or ends of the
bolts.

Same as above.

Same as above.

Same as above.

Ask your instructor
for help if needed.

(c) El Paso Community College, 1988

LEARNING EXPERIENCES

Performance Enabler No. 3

Demonstrate the making of a water system.

LEARNING ACTIVITIES

SPECIAL INSTRUCTIONS

Please Do Not Write Or Mark On This Guide

Read: Millwright and Mechanic's Guide,
pp. 397-435, "Pipe Fittings."

Demonstrate the threading of steel
pipe.

Demonstrate the layout procedure of
pipe flange bolt holes.

Demonstrate the bolt tightening
sequence for round pipe flange.

Follow standards set
forth on pp. 398-
403. Ask your in-
structor for neces-
sary material.

Follow the step-by-
step procedure on
p. 425.

Follow this sequence
very carefully so as
not to break the
flange.

Ask your instructor
for help if needed.

(c) El Paso Community College, 1988

LEARNING EXPERIENCES

Performance Enabler No. 4

Demonstrate the correct way to maintain valves in the system.

LEARNING ACTIVITIES

SPECIAL INSTRUCTIONS

Please Do Not Write Or Mark On This Guide

Read: Millwright and Mechanic's Guide,
pp. 437-459, "Pipe Valves."

View: Videotape "Valves."

Perform maintenance on a valve
assembly.

Dismantle the valve,
inspect and record
any problems found.
Recommend any re-
pairs or replace-
ments needed.

Turn in your inspec-
tion report and
recommendations to
your instructor.

(c) El Paso Community College, 1988

SELF-CHECK

DIRECTIONS

Complete each section of the self-check after finishing the appropriate enabler.

Please Do Not Write Or Mark On This Guide

1 - Demonstrate the making of external and internal threads.

1. Know the different types of threads.
2. Know the terms of screw thread.
3. Know how to tap internal threads.
4. Know how to tap external threads.
5. Know where the types of thread are used and why.

2 - Demonstrate the making of the proper mechanical fastener for the assigned job.

1. Know the common bolt, screw, and stud types.
2. Know the various classes of standard washers.
3. Know how to grade a bolt properly.
4. Know the types of standard pin fasteners.
5. Know the characteristics of mechanical fasteners.
6. Know where retaining rings are used.
7. Know how to measure a fastener correctly.

3 - Demonstrate the making of a water system.

1. Perform threading of steel pipe.
2. Show how pipe is measured.
3. Demonstrate layout of a pipe flange.
4. Show how the sequence of bolt tightening is performed.

4 - Demonstrate the correct way to maintain valves in the system.

1. Know valve styles.
2. Know how valves function.
3. Know how to install a valve.
4. Know how to perform maintenance of a valve.

STUDENT LEARNING GUIDE

**Advanced Industrial Technology Training Center
c/o El Paso Community College
P.O. Box 20500
El Paso, Texas 79998**

COURSE NUMBER AND TITLE: Mechanical Maintenance

DUTY/UNIT: Electricity and Pumps

COMPETENCY NUMBER: 5

COMPETENCY: TROUBLESHOOT ELECTRIC POWER & REPAIR PUMPS

INTRODUCTION:

The knowledge of electricity is very important to the industrial mechanic. You need to have a working knowledge of how electricity works. Pumps are used by almost every type of production operation. The mechanic must be able to repair pumps in order to keep production moving.

PERFORMANCE OBJECTIVE:

Given access to the trainer (or machinery) and the proper equipment, troubleshoot electrical power and repair pumps.

PERFORMANCE ENABLERS:

1. Demonstrate troubleshooting and understanding electricity.
2. Demonstrate the repair of pumps and how they work in the system.

Please Do Not Write Or Mark On This Guide

LEARNING EXPERIENCES

Performance Enabler No. 1

Demonstrate troubleshooting and understanding electricity.

LEARNING ACTIVITIES

SPECIAL INSTRUCTIONS

Please Do Not Write Or Mark On This Guide

Read: Millwright and Mechanic's Guide,
pp. 735-782.

View: Videotape "Basic Electricity
(Part 1)."

View: Videotape "Basic Electricity
(Part 2)."

View: Videotape on the correct use of
multimeters.

Troubleshoot electrical circuits using
a multimeter.

Troubleshoot the control panel of a
machine.

Ask your instructor
for help if needed.

Same as above.

Same as above.

Find the voltage,
amperage, and resis-
tance of the system.

Ask your instructor
to assign you a sys-
tem to work with.

Remember: Safety is
always first in mind
and body.

LEARNING EXPERIENCES

Performance Enabler No. 2

Demonstrate the repair of pumps and how they work in the system.

LEARNING ACTIVITIES

SPECIAL INSTRUCTIONS

Please Do Not Write Or Mark On This Guide

Read: Millwright and Mechanic's Guide,
pp. 845-872.

View: Videotape "Centrifugal Pumps
Part 1)."

View: Videotape "Centrifugal Pumps
(Part 2)."

View: Videotape "Maintaining Centrifugal
Pumps."

Demonstrate the repair of a centrifugal
pump.

Set up and connect pump to a driver
unit.

Ask your instructor
for help if needed.

Same as above.

Same as above.

Disassemble the
pump and inspect
for worn or broken
parts. Identify the
defective parts to
your instructor.

Use a rigid coupling
and align using a
straightedge and the
feeler gauge method.
Have your instructor
inspect the com-
pleted operation.

(c) El Paso Community College, 1988

SELF-CHECK

DIRECTIONS

Complete each self-check section after finishing the appropriate enabler.

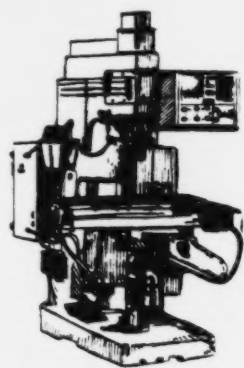
Please Do Not Write Or Mark On This Guide

1 - Demonstrate troubleshooting and understanding electricity.

1. Know electrical terms.
2. Know the parts of a circuit.
3. Have a working knowledge of motors.
4. Have a working knowledge of electrical wiring.
5. Know how to perform operations with the multimeter.

2 - Demonstrate the repair of pumps and how they work in the system.

1. Know the styles of pumps.
2. Know the parts of a pump.
3. Know how to develop a flow chart.
4. Know the causes of pump operating problems.



Student Learning Guide

A Project Funded by
The Texas Higher Education
Coordinating Board
Through the
Carl D. Perkins Act

Project No. 8788053

COMPUTER NUMERICAL CONTROL



**EL PASO
COMMUNITY
COLLEGE**

P.O. Box 20500, El Paso, Texas 79998

ADVANCED INDUSTRIAL TECHNOLOGY TRAINING CENTER

OFFICIAL COURSE OUTLINE

Subject Area: NC/CNC Programming

Code/Course Number:

Course Title: NC/CNC Programmer

Course Hours:

I. Catalog Description

This course will guide the practical student through the necessary skills to prepare computer-assisted numerical control programs for a Bridgeport CNC milling machine with the help of a Bridgeport EZ-CAM system. Also included is the operation of a Heidenhain TNC-151 control unit that can be programmed manually.

II. Course Objectives

Upon satisfactory completion of this course, the student will be able to:

- A. Demonstrate knowledge of fundamental CNC concepts.
- B. Demonstrate knowledge of operations of different elements of a CNC system.
- C. Command basic skills for programming CNC machine tools.
- D. Demonstrate knowledge of the elements of a Bridgeport CNC milling machine.
- E. Command necessary skills to operate a Bridgeport CNC milling machine.
- F. Demonstrate knowledge of a Heidenhain TNC-151 control unit keyboard.
- G. Command basic input statements for programming a Heidenhain TNC-151 control unit.

(Continued...)

- H. Demonstrate knowledge of computer fundamentals.
- I. Demonstrate knowledge of EZ-CAM programming system.
- J. Demonstrate knowledge of EZ-MILL software.
- K. Command use of existing hardware and software to program a CNC machine tool.

III. Unit Titles

Unit I — NC/CNC Fundamentals I. This unit introduces basics of CNC and the limitations and capabilities of CNC. It also presents basic standards for the industry. This unit is fundamental to further progress within the course.

Unit II — NC/CNC Fundamentals II. This is a continuation to the previous unit. It expands on other skills used in CNC programming. This unit is fundamental to further progress within the course.

Unit III — Machine Tools. This unit introduces the Bridgeport CNC vertical milling machine, its operation, its components, and the function of each. Safety is stressed, since CNC equipment improperly used can be very dangerous.

Unit IV — Control Unit. This unit introduces the Heidenhain TNC-151 control unit, its features and capabilities as they apply to the particular machine tool. The student will also learn manual programming with Heidenhain programming language and ISO format.

Unit V — Hardware/Software Fundamentals. This unit presents basic hardware/software concepts and how they apply to CNC programming. In particular, the EZ-CAM programming system, with its hardware elements, will be introduced. Competency in this unit is essential for acceptable results in the next unit.

Unit VI — EZ-MILL. This unit introduces the EZ-MILL software package for programming CNC machine tools. Upon completion of this unit, the student will be able to prepare different kinds of programs for a vertical milling machine that accepts source information from this system.

(Continued...)

IV. Texts and Materials

A. Required Texts:

1. Modern Machine Shop 1988 NC/CIM Guidebook,
Modern Machine Shop, 1988.
2. Fundamentals of Numerical Control, Allen
Bradley, 1976.

B. Materials:

1. Pen or pencil (student choice)
2. Notebook (quadrille paper, preferably)
3. Safety glasses which meet OSHA standards

V. Instructor's Resources

- A. Books (Same as above)
- B. Handouts as per instructor's discretion.

VI. Evaluation Measures

Performance Tests	30%	of grade
Lab Assignments	70%	of grade
TOTAL	100%	

GRADING SCALE

90 - 100	A
80 - 89	B
70 - 79	C
60 - 69	D
0 - 59	F

The grades of I (Incomplete) and W (Withdraw) will be given in accordance with current College policy.

STUDENT LEARNING GUIDE

**Advanced Industrial Technology Training Center
c/o El Paso Community College
P.O. Box 20500
El Paso, Texas 79998**

COURSE NUMBER AND TITLE: NC/CNC Programmer

DUTY/UNIT: Fundamentals of NC/CNC I

COMPETENCY NUMBER: 1

COMPETENCY: APPLY NC/CNC FUNDAMENTALS

INTRODUCTION:

In order to program, or even learn to program, an NC (numerically controlled) machine tool, it is necessary to command certain fundamental concepts, ideas, and terms used in preparing the programs and operating the related equipment. This learning guide will help you to acquire the fundamental knowledge necessary to begin learning how to program an NC/CNC machine tool.

PERFORMANCE OBJECTIVE:

Given a set of performance evaluation tests and exercises, apply NC/CNC fundamentals to solve the given problems and exercises.

PERFORMANCE ENABLERS:

1. Demonstrate knowledge of basic elements of a CNC system.
2. Demonstrate knowledge of Cartesian coordinates and use.
3. Demonstrate knowledge of the difference between point-to-point programming and contouring.
4. Given some basic part prints, prepare (on paper) basic instructions to perform cuts.

Please Do Not Write Or Mark On This Guide

LEARNING EXPERIENCES

Performance Enabler No. 1

Demonstrate knowledge of basic elements of a CNC system.

LEARNING ACTIVITIES

SPECIAL INSTRUCTIONS

Please Do Not Write Or Mark On This Guide

Read: Modern Machine Shop 1988 NC/CIM Guidebook, pp, 40-44 and 46-51.

Read: Fundamentals of Numerical Control, pp. 3-4.

Visit the AITTC machine shop and observe differences between manual machine tools and CNC machine tools.

Make a list of these observations.

Ask your instructor to arrange a visit to a manufacturing operation employing manual and CNC machine tools.

(c) El Paso Community College, 1988

LEARNING EXPERIENCES

Performance Enabler No. 2

Demonstrate knowledge of Cartesian coordinates and use.

LEARNING ACTIVITIES

SPECIAL INSTRUCTIONS

Please Do Not Write Or Mark On This Guide

Read: Modern Machine Shop 1988 NC/CIM Guidebook, pp. 93-95.

Read: Fundamentals of Numerical Control, pp. 5-6.

To check your knowledge and understanding of the Cartesian coordinate system, practice locating points on a quadrille sheet of paper as shown on the instruction sheet.

Ask your instructor for exercises that will help you to develop the necessary skill in using Cartesian coordinates.

(c) El Paso Community College, 1988

LEARNING EXPERIENCES

Performance Enabler No. 3

Demonstrate knowledge of the difference between point-to-point and contouring.

LEARNING ACTIVITIES

SPECIAL INSTRUCTIONS

Please Do Not Write Or Mark On This Guide

Read: Modern Machine Shop 1988 NC/CIM Guidebook, pp. 99-102.

Read: Fundamentals of Numerical Control, pp. 13-18.

Write a list of different types of programming required as per the samples shown on the instruction sheet.

Ask your instructor to arrange visits to shops in town that use different kinds of CNC machine tools.

Prepare a report after visiting each shop. Discuss it with your instructor.

(c) El Paso Community College, 1988

LEARNING EXPERIENCES

Performance Enabler No. 4

Given some basic part prints, prepare on paper basic instructions to perform the necessary cuts.

LEARNING ACTIVITIES

SPECIAL INSTRUCTIONS

Please Do Not Write Or Mark On This Guide

For various part prints provided, prepare basic instructions.

Practice transforming commands for above assignment into G-Code and M-Code.

Discuss with your instructor different alternatives for preparing the same part.

Study handouts.

PERFORMANCE TEST

STUDENT'S NAME

DATE

COMPETENCY NUMBER AND STATEMENT

TEST ATTEMPT

Apply NC/CNC Fundamentals

1ST 2ND 3RD

DIRECTIONS
(See below)

OVERALL EVALUATION:

PERFORMANCE LEVELS

- 4 Can perform this skill without supervision and with initiative and adaptability to problem situations.
- 3 Can perform this skill satisfactorily without assistance or supervision.
- 2 Can perform this skill satisfactorily but requires some assistance and/or supervision.
- 1 Can perform parts of this skill satisfactorily but requires considerable assistance and/or supervision.
- 0 Cannot perform this skill.

PERFORMANCE STANDARDS

For acceptable achievement, all items should receive a "yes" or "not applicable" response.

Directions: Your instructor will provide you with some basic part prints and a written exam that will have to be completed within a reasonable amount of time.

1—Knowledge of Basic CNC

- 1. Student understands purpose of CNC.
- 2. Student understands capabilities of CNC.
- 3. Student understands basic elements of CNC.

(Continued...)

YES	NO	NOT APPL.

PERFORMANCE TEST (CONT.)

PERFORMANCE STANDARDS

FOR ACCEPTABLE ACHIEVEMENT, ALL ITEMS SHOULD RECEIVE A "YES" OR "NOT APPLICABLE" RESPONSE
YES NO NOT APPL.

2-Cartesian Coordinates

1. Student understands basic Cartesian coordinates.
2. Student can apply Cartesian coordinates to different parts.
3. Student can manipulate three-dimensional concepts.

3-Basic Programming

1. Student understands point-to-point programming.
2. Student understands contour programming.
3. Student understands need for programming.

4-Basic Skills

1. Student commands basic concepts of CNC.
 2. Student can apply fundamentals to simple exercises.
 3. Student is ready for next competency.
-

STUDENT LEARNING GUIDE

**Advanced Industrial Technology Training Center
c/o El Paso Community College
P.O. Box 20500
El Paso, Texas 79998**

COURSE NUMBER AND TITLE: NC/CNC Programmer

DUTY/UNIT: Fundamentals of NC/CNC II

COMPETENCY NUMBER: 2

COMPETENCY: APPLY NC/CNC FUNDAMENTALS

INTRODUCTION:

In order to program, or even learn to program, an NC (numerically controlled) machine tool, it is necessary to command certain fundamental concepts, ideas, and terms used in preparing the programs and operating the related equipment. This learning guide will help you to acquire the fundamental knowledge necessary to begin learning how to program an NC/CNC machine tool.

PERFORMANCE OBJECTIVE:

Given a set of performance evaluation tests and exercises, apply NC/CNC fundamentals to solve the given problems and exercises.

PERFORMANCE ENABLERS:

1. Demonstrate knowledge of G-Code, M-Code and their use.
2. Demonstrate an understanding of the difference between absolute and incremental dimensioning.
3. Demonstrate knowledge of various types of interpolation.
4. Demonstrate knowledge of left-hand rule as it applies to existing equipment.
5. Given some basic instructions and written exercises, prepare a basic program for CNC.

Please Do Not Write Or Mark On This Guide

LEARNING EXPERIENCES

Performance Enabler No. 1

Demonstrate knowledge of G-Code and M-Code and their use.

LEARNING ACTIVITIES

SPECIAL INSTRUCTIONS

Please Do Not Write Or Mark On This Guide

Study handout given by instructor.

Study copies of G-Code formatted programs printout handed out by instructor.

Practice self-test included.

Write code definitions and assign a number and letter to it to ensure commitment to memory.

(c) El Paso Community College, 1988

LEARNING EXPERIENCES

Performance Enabler No. 2

Demonstrate knowledge of the difference between absolute and incremental dimensioning.

LEARNING ACTIVITIES

SPECIAL INSTRUCTIONS

Please Do Not Write Or Mark On This Guide

Read: Modern Machine Shop 1988 NC/CIM Guidebook, pp. 102-105.

Read: Fundamentals of Numerical Control, p. 23: Paragraph on absolute and incremental data.

Refer to the instruction sheet and make a list of the types of dimensions on the print.

If you need assistance, ask your instructor.

(c) El Paso Community College, 1988

LEARNING EXPERIENCES

Performance Enabler No. 3

Demonstrate knowledge of various types of interpolation.

LEARNING ACTIVITIES

SPECIAL INSTRUCTIONS

Please Do Not Write Or Mark On This Guide

Read: Modern Machine Shop 1988 NC/CIM Guidebook, pp. 106-110

Read: Fundamentals of Numerical Control, pp. 17-18.

Examine the instruction sheet and make a list of the types of interpolation required for each to complete work on CNC equipment.

(c) El Paso Community College, 1988

LEARNING EXPERIENCES

Performance Enabler No. 4

Demonstrate knowledge of left-hand rule as it applies to existing equipment.

LEARNING ACTIVITIES

SPECIAL INSTRUCTIONS

Please Do Not Write Or Mark On This Guide

Read: Modern Machine Shop, 1988 NC/CIM Guidebook, pp. 52-62.

Read: Fundamentals of Numerical Control, pp. 7-12.

Your instructor will provide you with a handout on different machine tools. Follow the instructions and review with the instructor.

(c) El Paso Community College, 1988

LEARNING EXPERIENCES

Performance Enabler No. 5

Given a set of written instructions and exercises, prepare a basic program for CNC.

LEARNING ACTIVITIES

SPECIAL INSTRUCTIONS

Please Do Not Write Or Mark On This Guide

Your instructor will provide you with a print for which you are to prepare a basic operations list in a G-Code format. Review with your instructor.

Note:
Continue preparing these programs until proficiency has been developed.

(c) El Paso Community College, 1988

PERFORMANCE TEST

STUDENT'S NAME

DATE

COMPETENCY NUMBER AND STATEMENT

2- Apply NC/CNC Fundamentals

TEST ATTEMPT

1ST 2ND 3RD

DIRECTIONS

(See below)

OVERALL EVALUATION:

PERFORMANCE LEVELS

- 4 Can perform this skill without supervision and with initiative and adaptability to problem situations.
- 3 Can perform this skill satisfactorily without assistance or supervision.
- 2 Can perform this skill satisfactorily but requires some assistance and/or supervision.
- 1 Can perform parts of this skill satisfactorily but requires considerable assistance and/or supervision.
- 0 Cannot perform this skill.

PERFORMANCE STANDARDS

For acceptable achievement, all items should receive a "yes" or "not applicable" response.

Directions: Your instructor will provide you with written exercises and instruction sheets which should be completed in a reasonable amount of time.

1-G-Code/M-Code

- 1. Student commands G-Code.
- 2. Student commands M-Code.
- 3. Student can apply ISO format to simple part prints.

(Continued...)

YES	NO	NOT APPL.

PERFORMANCE TEST (CONT.)

PERFORMANCE STANDARDS

FOR ACCEPTABLE ACHIEVEMENT, ALL ITEMS SHOULD RECEIVE A "YES" OR "NOT APPLICABLE" RESPONSE
YES NO NOT APPL.

2-CNC Dimensioning

1. Student understands absolute dimensioning.
2. Student understands incremental dimensioning.
3. Student applies different kinds of dimensions to part prints.

3-Interpolation

1. Student understands linear interpolation.
2. Student understands circular interpolation.
3. Student understands helical interpolation.
4. Student understands existence of other types of interpolation.

4-Machine Tool Axes

1. Student commands left-hand rule.
2. Student understands application to different machine tools.
3. Student commands existing equipment axis configuration.

5-Basic Skills

1. Student can apply basic concepts to instruction given.
2. Student can prepare simple programs.
3. Student can proceed to next learning guide.

Please Do Not Write Or Mark On This Guide

STUDENT LEARNING GUIDE

**Advanced Industrial Technology Training Center
c/o El Paso Community College
P.O. Box 20500
El Paso, Texas 79998**

COURSE NUMBER AND TITLE: NC/CNC Programmer

DUTY/UNIT: Machine Tool

COMPETENCY NUMBER: 3

**COMPETENCY: COMMAND BASIC SKILLS TO OPERATE A BRIDGEPORT
CNC MILLING MACHINE**

INTRODUCTION:

CNC has one purpose only: to control a machine tool in a certain prescribed manner in order to fabricate machined parts. The machine tool in this case is a Bridgeport vertical milling machine. This learning guide will teach you the basic required skills to operate the equipment.

PERFORMANCE OBJECTIVE:

Presented with the opportunity to operate a CNC milling machine, perform, in a safe, the accepted, and timely manner.

PERFORMANCE ENABLERS:

1. Demonstrate basic safety procedures when operating a Bridgeport CNC milling machine.
2. Demonstrate knowledge of machine tool and control interaction.
3. Demonstrate knowledge of basic machine axes.
4. Given a set of basic written instructions, perform them in an acceptable amount of time, observing basic safety procedures.

Please Do Not Write Or Mark On This Guide

LEARNING EXPERIENCES

Performance Enabler No. 1

Demonstrate basic safety when operating a Bridgeport CNC milling machine.

LEARNING ACTIVITIES

SPECIAL INSTRUCTIONS

Please Do Not Write Or Mark On This Guide

Read: Safety Manual for Bridgeport Milling Machines.

Read: Modern Machine Shop 1988 NC/CIM Guidebook, p. 42: Paragraph "What NC is Not."

Complete safety test.

Do not proceed to manipulate equipment until you have been cleared on the written test and are supervised by a lab technician.

(c) El Paso Community College, 1988

LEARNING EXPERIENCES

Performance Enabler No. 2

Demonstrate knowledge of interaction between machine tool and control.

LEARNING ACTIVITIES

SPECIAL INSTRUCTIONS

Please Do Not Write Or Mark On This Guide

Read: Modern Machine Shop 1988 NC/CIM Guidebook, pp. 63-74.

(c) El Paso Community College, 1988

LEARNING EXPERIENCES

Performance Enabler No. 3

Demonstrate knowledge of basic CNC machining axes as related to equipment.

LEARNING ACTIVITIES

SPECIAL INSTRUCTIONS

Please Do Not Write Or Mark On This Guide

Read: Modern Machine Shop 1988 NC/CIM Guidebook, pp. 52-62.

Read: Fundamentals of Numerical Control, pp. 7-12.

Go to the lab and sketch the available equipment, designating axes of motion if the equipment were CNC. Consult with the instructor and review.

Have the instructor set up a visit to a local CNC shop.

(c) El Paso Community College, 1988

LEARNING EXPERIENCES

Performance Enabler No. 4

Given a set of basic written instructions, perform them in a safe, acceptable, and timely manner.

LEARNING ACTIVITIES

SPECIAL INSTRUCTIONS

Please Do Not Write Or Mark On This Guide

Your instructor will supply you with written instructions to be performed in the laboratory in a reasonable amount of time.

Consult and review with your instructor.

Note:

Do not proceed to the next step until your instructor certifies you on the previous one.

(c) El Paso Community College, 1988

PERFORMANCE TEST

STUDENT'S NAME

DATE

COMPETENCY NUMBER AND STATEMENT

TEST ATTEMPT

3—Command basic skills to operate a Bridgeport CNC milling machine.

1ST 2ND 3RD

DIRECTIONS

(See below)

OVERALL EVALUATION:

PERFORMANCE LEVELS

- 4 Can perform this skill without supervision and with initiative and adaptability to problem situations.
- 3 Can perform this skill satisfactorily without assistance or supervision.
- 2 Can perform this skill satisfactorily but requires some assistance and/or supervision.
- 1 Can perform parts of this skill satisfactorily but requires considerable assistance and/or supervision.
- 0 Cannot perform this skill.

PERFORMANCE STANDARDS

For acceptable achievement, all items should receive a "yes" or "not applicable" response.

	YES	NO	NOT APPL.
Directions: Your instructor will provide you with written instructions that should be executed in a safe and timely manner. <u>1-Safety</u> - Student uses safety equipment properly. - Student conducts himself in a safe manner around equipment. - Student watches over safety of those near equipment. (Continued...)			

PERFORMANCE TEST (CONT.)

PERFORMANCE STANDARDS

FOR ACCEPTABLE ACHIEVEMENT, ALL ITEMS SHOULD RECEIVE A "YES" OR "NOT APPLICABLE" RESPONSE
YES NO NOT APPL.

2-Machine Tool/Control Interaction

1. Student recognizes elements of a CNC system.
2. Student can explain function of each element.
3. Student can operate basic equipment.

3-Machine Axes

1. Student commands left-hand rule.
2. Student can apply left-hand rule to existing equipment.
3. Student can identify different axes on machine tools.
4. Student can manipulate different mathematical operations on axes.

4-Operation

1. Student continually observes safety and proper procedures.
2. Student develops his familiarity with equipment.

Please Do Not Write Or Mark On This Guide

STUDENT LEARNING GUIDE

Advanced Industrial Technology Training Center
c/o El Paso Community College
P.O. Box 20500
El Paso, Texas 79998

COURSE NUMBER AND TITLE: NC/CNC Programmer

DUTY/UNIT: CNC Control Unit

COMPETENCY NUMBER: 4

COMPETENCY: OPERATE HEIDENHAIN TNC-151 CONTROL UNIT

INTRODUCTION:

The operations that a machine tool performs are stored and interpreted by a control unit. This control unit sends and receives signals to the machine tool part that performs the actual machining. This learning guide will teach you how to operate a Heidenhain TNC-151 control unit.

PERFORMANCE OBJECTIVE:

Given a simple part print, perform necessary input commands to accomplish fabrication of such part on a machine tool fitted with Heidenhain TNC-151 control unit.

PERFORMANCE ENABLERS:

1. Demonstrate knowledge of interaction of control unit and machine tools.
2. Demonstrate knowledge of keyboard layout and function of each key on the Heidenhain TNC-151 control unit.
3. Demonstrate knowledge of MDI programming techniques for the Heidenhain TNC-151 control unit.
4. Demonstrate knowledge of ISO format programming techniques for the Heidenhain TNC-151 control unit.
5. Demonstrate knowledge of the procedure to couple external data transmission units to the Heidenhain TNC-151 control unit.
6. Given access to a Heidenhain TNC-151 control unit coupled to a suitable machine tool, perform basic input functions to accomplish machining of different parts.

Please Do Not Write Or Mark On This Guide

LEARNING EXPERIENCES

Performance Enabler No. 1

Demonstrate knowledge of interaction between control unit and machine tool.

LEARNING ACTIVITIES

SPECIAL INSTRUCTIONS

Please Do Not Write Or Mark On This Guide

Read: Modern Machine Shop 1988 NC/CIM Guidebook, pp. 62-75.

Read: Fundamentals of Numerical Control, pp. 19-25, pp. 27-29, and pp. 31-35.

Have your instructor arrange a demonstration by the lab technician.

(c) El Paso Community College, 1988

LEARNING EXPERIENCES

Performance Enabler No. 2

Demonstrate knowledge of keyboard layout and function of each key on the Heidenhain TNC-151 control unit.

LEARNING ACTIVITIES

SPECIAL INSTRUCTIONS

Please Do Not Write Or Mark On This Guide

Read: Heidenhain Pilot (Complete).

After reading
Pilot, familiarize
yourself with the
actual keyboard.

Ask the instructor
for practice over-
lay. When you score
100%, continue.

(c) El Paso Community College, 1988

LEARNING EXPERIENCES

Performance Enabler No. 3

Demonstrate knowledge of MDI programming techniques for the Heidenhain TNC-151 control unit.

LEARNING ACTIVITIES

SPECIAL INSTRUCTIONS

Please Do Not Write Or Mark On This Guide

Read: Heidenhain Operating Manual,
pp. M-1 through P-129.

As you go through
the manual, ask the
lab technician to
demonstrate each
one of the func-
tions learned.

Consult and review
with instructor.

(c) El Paso Community College, 1988

LEARNING EXPERIENCES

Performance Enabler No. 4

Demonstrate knowledge of ISO format programming for the Heidenhain TNC-151 control unit.

LEARNING ACTIVITIES

SPECIAL INSTRUCTIONS

Please Do Not Write Or Mark On This Guide

Read: Heidenhain Operating Manual,
pp. D-1 through D-32.

As you go through
the manual, ask the
lab technician to
demonstrate each
one of the functions
learned.

Consult and review
with instructor.

(c) El Paso Community College, 1988

LEARNING EXPERIENCES

Performance Enabler No. 5

Demonstrate knowledge of the procedure to couple external data transmission units to the Heidenhain TNC-151 control unit.

LEARNING ACTIVITIES

SPECIAL INSTRUCTIONS

Please Do Not Write Or Mark On This Guide

Read: Heidenhain Operating Manual,
pp. V-1 through V-17.

Ask your instructor
to set up a demon-
stration of the op-
erating procedures.

Lab technician will
assist you with
practice sessions.

LEARNING EXPERIENCES

Performance Enabler No. 6

Given access to a Heidenhain TNC-151 control unit coupled to a suitable machine tool, perform basic input functions to accomplish machining of different parts.

LEARNING ACTIVITIES

SPECIAL INSTRUCTIONS

Please Do Not Write Or Mark On This Guide

Program machine for different parts as per instructor's handouts.

Refer to operating manual if necessary.

Lab technician will inspect finished work.

PERFORMANCE TEST

STUDENT'S NAME

DATE

COMPETENCY NUMBER AND STATEMENT

TEST ATTEMPT

4 - Operate Heidenhain TNC-151
control unit.

1ST 2ND 3RD

DIRECTIONS
(See below)

OVERALL EVALUATION:

PERFORMANCE LEVELS

- 4 Can perform this skill without supervision and with initiative and adaptability to problem situations.
- 3 Can perform this skill satisfactorily without assistance or supervision.
- 2 Can perform this skill satisfactorily but requires some assistance and/or supervision.
- 1 Can perform parts of this skill satisfactorily but requires considerable assistance and/or supervision.
- 0 Cannot perform this skill.

PERFORMANCE STANDARDS

For acceptable achievement, all items should receive a "yes" or "not applicable" response.

	YES	NO	NOT APPL.
Directions: Your instructor will provide you with a part print for which a CNC program will be prepared using the Heidenhain TNC-151 control unit. First, with Heidenhain language; then with ISO format. Final results will be inspected by the lab technician.			
<u>1-Control/machine Tool Interaction</u>			
1. Student demonstrates knowledge of purpose of machine tool control unit.			
(Continued...)			

PERFORMANCE TEST (CONT.)

PERFORMANCE STANDARDS

FOR ACCEPTABLE ACHIEVEMENT, ALL ITEMS SHOULD RECEIVE A "YES" OR "NOT APPLICABLE" RESPONSE
YES NO NOT APPL.

2-Keyboard Layout

1. Student demonstrates knowledge of function of each key.
2. Student commands manual use of keyboard.
3. Student prepares simple program with ease.

3-MDI Programming

1. Student follows standard method in preparing programs.
2. Student displays pragmatic methods when programming.
3. Student demonstrates knowledge of control unit capabilities.

4-ISO Format Programming

1. Student demonstrates knowledge of ISO format.
2. Student demonstrates knowledge of ISO format mode of control unit.
3. Student demonstrates proficiency when using ISO format.

5-External Data Transmission

1. Student demonstrates knowledge of hardware requirements.
2. Student demonstrates knowledge of downloading procedures.
3. Student demonstrates knowledge of troubleshooting capabilities.

6-Proficiency

1. Student commands use of MDI capabilities of Heidenhain control when programming.

Please Do Not Write Or Mark On This Guide

STUDENT LEARNING GUIDE

**Advanced Industrial Technology Training Center
c/o El Paso Community College
P.O. Box 20500
El Paso, Texas 79998**

COURSE NUMBER AND TITLE: NC/CNC Programmer

DUTY/UNIT: NC/CNC Hardware and Software I

COMPETENCY NUMBER: 5

COMPETENCY: SHOW PROFICIENCY WITH NC/CNC HARDWARE & SOFTWARE

INTRODUCTION:

Many of today's machined parts do not allow simple CNC programs to be prepared. To accomplish programming, computer-assisted methods have been devised. EZ-CAM is one of these methods of programming. This learning guide will teach you how to use computer hardware and software to prepare complicated programs as they relate to EZ-CAM.

PERFORMANCE OBJECTIVE:

Given access to EZ-CAM software and appropriate hardware, prepare CNC programs for different types of parts.

PERFORMANCE ENABLERS:

1. Demonstrate knowledge of computer hardware/software fundamentals.
2. Demonstrate knowledge of EZ-CAM.
3. Demonstrate knowledge of the use of the different modules in EZ-Cam.
4. Demonstrate knowledge of procedures for connecting EZ-CAM systems and downloading programs.
5. Given access to EZ-CAM and appropriate hardware, connect, start up, and initiate programming sequence.

Please Do Not Write Or Mark On This Guide

LEARNING EXPERIENCES

Performance Enabler No. 1

Demonstrate knowledge of computer hardware/software fundamentals.

LEARNING ACTIVITIES

SPECIAL INSTRUCTIONS

Please Do Not Write Or Mark On This Guide

Read: Modern Machine Shop 1988 NC/CIM Guidebook, Chapter III.

Read: Modern Machine Shop 1988 NC/CIM Guidebook, Chapter V.

Read: NEC Owner's Manual for model.

Arrange for your instructor to have a demonstration of the hardware and software which is available for this class.

(c) El Paso Community College, 1988

LEARNING EXPERIENCES

Performance Enabler No. 2

— Demonstrate knowledge of EZ-CAM.

LEARNING ACTIVITIES

SPECIAL INSTRUCTIONS

Please Do Not Write Or Mark On This Guide

Read: Bridgeport EZ-CAM system training manual.

With lab technician's supervision, practice different exercises on system.

Arrange for your instructor to give a demonstration of existing software.

(c) El Paso Community College, 1988

LEARNING EXPERIENCES

Performance Enabler No. 3

Demonstrate knowledge of the different modules in EZ-CAM.

LEARNING ACTIVITIES

SPECIAL INSTRUCTIONS

Please Do Not Write Or Mark On This Guide

Read: Bridgeport EZ-CAM manual.

With assistance from lab technicians,
practice different exercises on EZ-CAM
software.

Have your instructor
arrange a demonstra-
tion of existing
equipment and soft-
ware.

(c) El Paso Community College, 1988

LEARNING EXPERIENCES

Performance Enabler No. 4

Demonstrate knowledge of procedures for connecting EZ-CAM systems and downloading programs.

LEARNING ACTIVITIES

SPECIAL INSTRUCTIONS

Please Do Not Write Or Mark On This Guide

Read: Hardware operating manual section(s) pertaining to hook-up procedures.

Ask your instructor to prepare a demonstration.

LEARNING EXPERIENCES

Performance Enabler No. 5

Given access to EZ-CAM and appropriate hardware, connect, start up, and initiate programming sequence.

LEARNING ACTIVITIES

SPECIAL INSTRUCTIONS

Please Do Not Write Or Mark On This Guide

Practice hook-up and start-up of
EZ-CAM software in host hardware.

Your instructor will
assist you.

(c) El Paso Community College, 1988

PERFORMANCE TEST

STUDENT'S NAME

DATE

COMPETENCY NUMBER AND STATEMENT

TEST ATTEMPT

5 - Show proficiency with NC/CNC hardware and software.

1ST 2ND 3RD

DIRECTIONS

(See below)

OVERALL EVALUATION:

PERFORMANCE LEVELS

- 4 Can perform this skill without supervision and with initiative and adaptability to problem situations.
- 3 Can perform this skill satisfactorily without assistance or supervision.
- 2 Can perform this skill satisfactorily but requires some assistance and/or supervision.
- 1 Can perform parts of this skill satisfactorily but requires considerable assistance and/or supervision.
- 0 Cannot perform this skill.

PERFORMANCE STANDARDS

For acceptable achievement, all items should receive a "yes" or "not applicable" response.

	YES	NO	NOT APPL.
Directions: In the lab setting, your instructor will allow you to hook up and start up EZ-CAM software modules and hardware. You should complete this assignment in a timely and proficient manner.			
<u>1-Computer Hardware</u>			
1. Student demonstrates knowledge of computer hardware functions.			
(Continued...)			

PERFORMANCE TEST (CONT.)

PERFORMANCE STANDARDS

FOR ACCEPTABLE ACHIEVEMENT, ALL ITEMS SHOULD RECEIVE A "YES" OR "NOT APPLICABLE" RESPONSE
YES NO NOT APPL.

2-Computer Software

- | | | | |
|--|--|--|--|
| 1. Student demonstrates knowledge of function of CNC software. | | | |
| 2. Student demonstrates knowledge of procedure for loading software. | | | |
| 3. Student demonstrates knowledge of the use of EZ-CAM. | | | |
| 4. Student demonstrates knowledge of various EZ-CAM modules. | | | |
| 5. Student demonstrates knowledge of procedure for downloading programs. | | | |

3-Proficiency with EZ-CAM

- | | | | |
|--|--|--|--|
| 1. Student commands skill to operate hardware with appropriate software. | | | |
|--|--|--|--|
-

STUDENT LEARNING GUIDE

Advanced Industrial Technology Training Center
c/o El Paso Community College
P.O. Box 20500
El Paso, Texas 79998

COURSE NUMBER AND TITLE: NC/CNC Programmer

DUTY/UNIT: NC/CNC Hardware/Software II

COMPETENCY NUMBER: 6

COMPETENCY: SHOW PROFICIENCY IN THE USE OF EZ-MILL SOFTWARE

INTRODUCTION:

Many of today's machined parts do not allow simple CNC programming to be prepared. To accomplish programming, computer-assisted methods have been devised. EZ-MILL is a software package that allows programming of complicated parts. This learning guide will teach you how to use EZ-MILL and the appropriate hardware.

PERFORMANCE OBJECTIVE:

Given access to EZ-MILL software and appropriate hardware, prepare CNC programs for different parts to be machined on a Bridgeport CNC milling machine.

PERFORMANCE ENABLERS:

1. Demonstrate knowledge of EZ-MILL's basic capabilities.
2. Demonstrate knowledge of different modules in EZ-MILL.
3. Demonstrate knowledge of applications of EZ-MILL software to prepare CNC programs.
4. Command operating functions to load programs from computer to machine tool control.
5. Given access to EZ-MILL software and hardware, prepare programs in an efficient and accepted manner.

Please Do Not Write Or Mark On This Guide

PERFORMANCE TEST (CONT.)

PERFORMANCE STANDARDS

FOR ACCEPTABLE ACHIEVEMENT, ALL ITEMS SHOULD RECEIVE A "YES" OR "NOT APPLICABLE" RESPONSE

YES NO NOT APPL.

1-EZ-MILL Software

1. Student demonstrates knowledge of the use of EZ-MILL software.
2. Students demonstrates knowledge of EZ-MILL capabilities.
3. Student commands hardware operation with EZ-MILL software.

2-Proficiency

1. Student commands pragmatic techniques in preparing CNC programs.
 2. Student commands use of available hardware and software.
 3. Student demonstrates knowledge of downloading procedures.
 4. Student demonstrates knowledge of setting up machine tools.
 5. Student demonstrates knowledge of proofing procedures.
 6. Student uses time efficiently in preparing programs.
 7. Student demonstrates knowledge of editing existing or incorrect programs.
 8. Student produces parts which are dimensionally accurate.
-

LEARNING EXPERIENCES

Performance Enabler No. 1

Demonstrate knowledge of EZ-MILL's basic capabilities.

LEARNING ACTIVITIES

SPECIAL INSTRUCTIONS

Please Do Not Write Or Mark On This Guide

Read: Bridgeport EZ-MILL User's Manual,
Chapter 1 (Complete).

Ask your instructor
to set up a demon-
stration.

The lab technician
will assist you in
completing lab as-
signments from your
instructor.

LEARNING EXPERIENCES

Performance Enabler No. 2

Demonstrate knowledge of different modules of EZ-MILL.

LEARNING ACTIVITIES

SPECIAL INSTRUCTIONS

Please Do Not Write Or Mark On This Guide

Review: Chapter 1 of the Bridgeport EZ-MILL User's Manual.

Read: Bridgeport EZ-MILL User's Manual, Chapter 2—5.

Ask your instructor to arrange for a demonstration.

The lab technician will assist you in completing lab assignments from your instructor.

LEARNING EXPERIENCES

Performance Enabler No. 3

Demonstrate knowledge of applications of EZ-MILL software to prepare CNC programs.

LEARNING ACTIVITIES

SPECIAL INSTRUCTIONS

Please Do Not Write Or Mark On This Guide

Review: Chapters 1—5, Bridgeport
EZ-MILL User's Manual.

Read: Chapter 6 of manual.

Ask your instructor
to arrange a demon-
stration.

The lab technician
will assist you in
completing lab as-
signments from your
instructor.

(c) El Paso Community College, 1988

LEARNING EXPERIENCES

Performance Enabler No. 4

Command operating functions to load program from computer to machine tool.

LEARNING ACTIVITIES

SPECIAL INSTRUCTIONS

Please Do Not Write Or Mark On This Guide

Review: Heidenhain Operating Manual,
"External Data Transmission" section.

Review: Chapter 4 of Bridgeport
EZ-MILL User's Manual.

Practice downloading existing or newly
generated programs.

The lab technician
will assist you in
completing lab as-
signments.

(c) El Paso Community College, 1988

LEARNING EXPERIENCES

Performance Enabler No. 5

Given access to EZ-MILL software and hardware, prepare programs in an efficient and accepted manner.

LEARNING ACTIVITIES

SPECIAL INSTRUCTIONS

Please Do Not Write Or Mark On This Guide

Practice preparing, downloading, proofing, and editing programs for different types of parts as per instructor's handout.

Consult and review with instructor.

The lab technician will assist you in completing lab assignments.

(c) El Paso Community College, 1988

PERFORMANCE TEST

STUDENT'S NAME

DATE

COMPETENCY NUMBER AND STATEMENT

TEST ATTEMPT

6 - Show proficiency in the use of
EZ-MILL software.

1ST 2ND 3RD

DIRECTIONS
(See below)

OVERALL EVALUATION:

PERFORMANCE LEVELS

- 4 Can perform this skill without supervision and with initiative and adaptability to problem situations.
- 3 Can perform this skill satisfactorily without assistance or supervision.
- 2 Can perform this skill satisfactorily but requires some assistance and/or supervision.
- 1 Can perform parts of this skill satisfactorily but requires considerable assistance and/or supervision.
- 0 Cannot perform this skill.

PERFORMANCE STANDARDS

For acceptable achievement, all items should receive a "yes" or "not applicable" response.

	YES	NO	NOT APPL.
Directions: Your instructor will provide you with a part print for which you are to prepare a CNC program using EZ-MILL software and appropriate hardware. You will download this program to compatible control units, proof out, and edit if necessary. Finish parts will be checked for dimensional accuracy by the lab technician. (Continued...)			

INDEX OF INDUSTRIAL CURRICULUM PROJECTS—JUNE 1988

I. Plastics Technology

- A. Plastic Materials and Applications
 - 1. Structures of Plastic Materials
 - 2. Types of Materials and Applications
 - 3. Processes and Production Methods
- B. Injection Molds and Mold Maintenance
 - 1. Mold Materials and Components
 - 2. Mold Maintenance
- C. Injection Molding Machine Operation
 - 1. Injection Molding Machine Operation
- D. Injection Molding Process Control and Troubleshooting
 - 1. Process Control Technology
 - 2. Troubleshooting
- E. Auxiliary Equipment and Material Handling
 - 1. Overview of Auxiliary Equipment
 - 2. Material Handling
 - 3. Water Chilling and Recovery Equipment

II. Industrial Maintenance

- A. Pneumatic Controls
 - 1. Control of Pneumatic Energy
 - 2. Compressor Systems
 - 3. Pneumatic Controls
 - 4. Regulation of the Pneumatic System

(Continued...)

B. Hydraulics II

1. Fundamentals of Hydraulics
2. Hydraulic Fluids
3. Control of Fluid Movement
4. Hydraulic Energy and Mechanical Work

C. Hydraulics III

1. Advanced Circuits
2. Advanced Valves
3. Actuators and Troubleshooting

D. Print Reading for Machine Trades

1. Industry's Means of Communication
2. Using Correct Measurements
3. Drawing Views
4. Finish and Practices

E. Mechanical Maintenance

1. Basic Mechanical Introduction
2. Power Transmission
3. Support Hardware
4. Fasteners and Piping Systems
5. Electricity and Pumps

III. NC/CNC Programming

A. NC/CNC Programmer

1. Fundamentals of NC/CNC I
2. Fundamentals of NC/CNC II
3. Machine Tool
4. CNC Control Unit
5. NC/CNC Hardware and Software I
6. NC/CNC Hardware and Software II